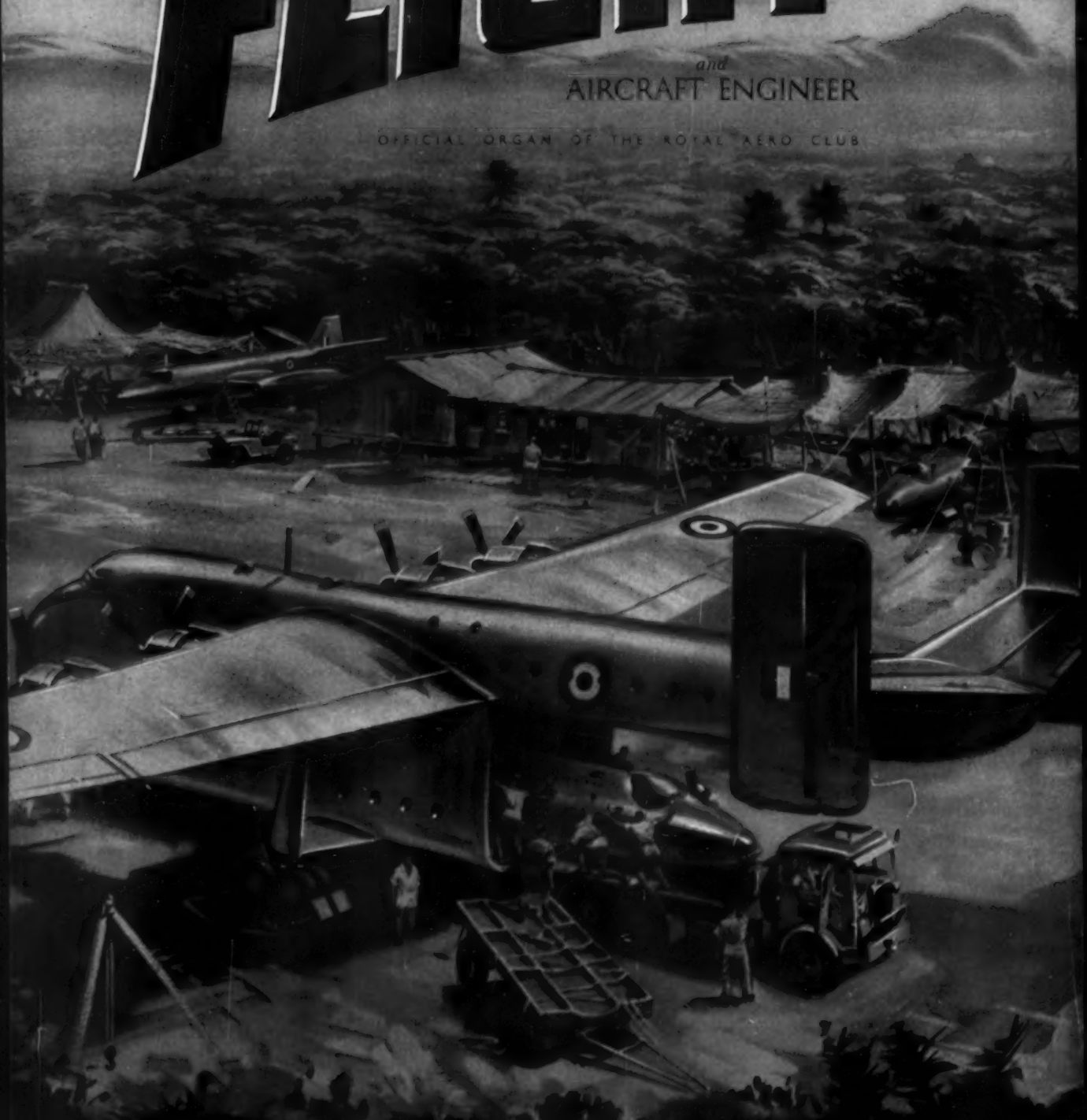
26 OCTOBER 1956 ONE SHILLING & SIXPENCE

FLIGHT

and

AIRCRAFT ENGINEER

OFFICIAL ORGAN OF THE ROYAL AERO CLUB



FOR RECOVERY AND SUPPLY

Beverley

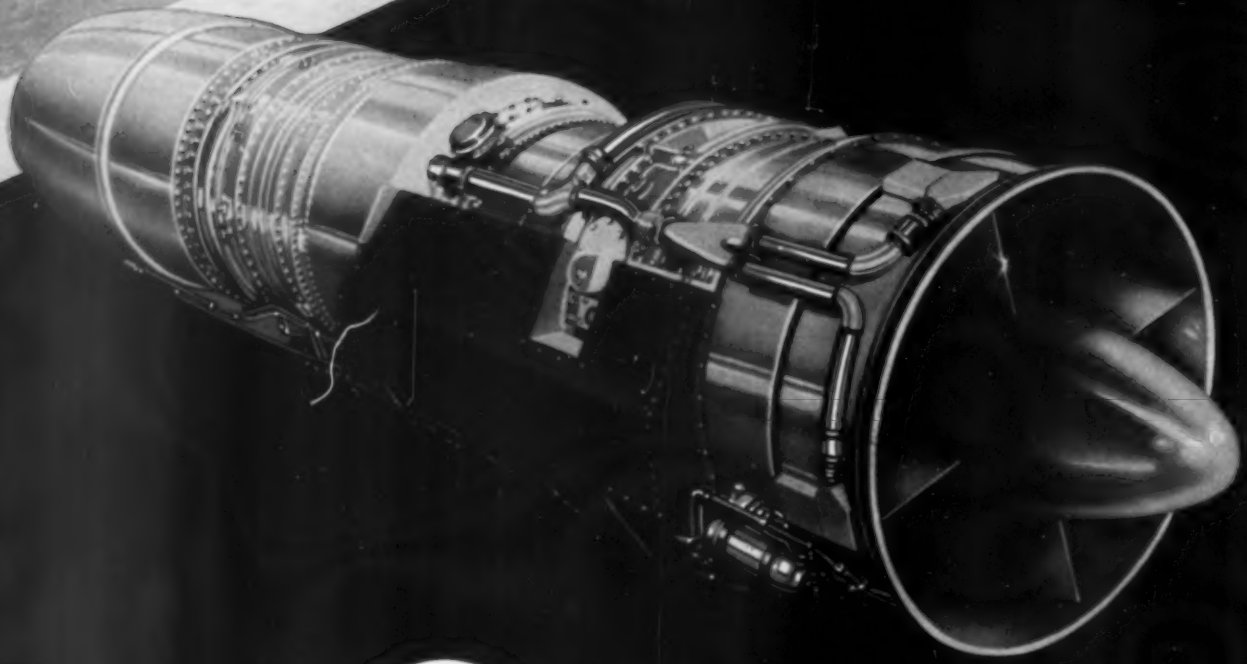
Blackburn and General Aircraft Limited, Brough, E. Yorks

IROQUOIS,

Orenda's supersonic turbojet,

has passed its fifty hour flight rating test—

successfully, and on schedule.



ORENDA

ENGINES LIMITED

MALTON, CANADA

MEMBER: A. V. ROE CANADA LIMITED & THE HAWKER SIDDELEY GROUP

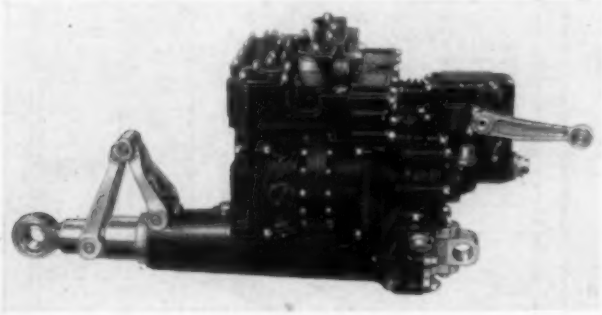
Hobson

POWER FLYING CONTROLS

are now specified for the

Gloster "Javelin"

BRITAIN'S ALL-WEATHER DAY AND NIGHT FIGHTER



Many of Britain's leading aircraft designers are now specifying Hobson Power Flying Controls for operation of the primary control surfaces, including "All-Flying" or "Slab" tailplanes. The duplicated hydraulically operated single screw jack unit, as illustrated, is typical of Hobson units fitted to the Gloster Javelin.

H. M. HOBSON LIMITED · FORDHOUSES · WOLVERHAMPTON

Licensees in U.S.A.: Simmonds Aerocessories Inc., Tarrytown, NEW YORK, U.S.A.

Agents in France: Societe Commerciale et Industrielle Franco - Britannique, 48 Avenue Raymond Poincare, PARIS XVI.

Licensees in Italy: Secondo Mona, SOMMA LOMBARDO.

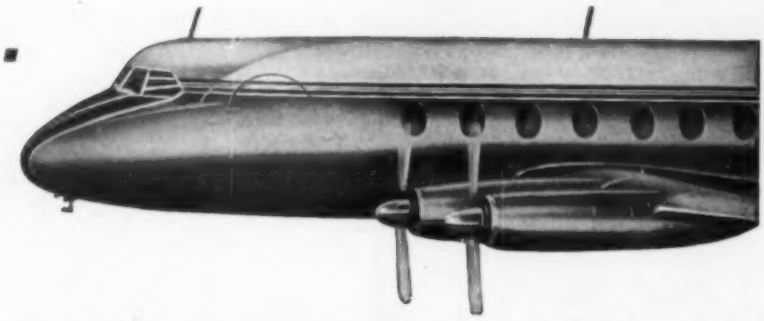
Agents in Australia: Aeronautical Supply Co. Pty. Ltd., 210 Victoria Street, MELBOURNE, Victoria.

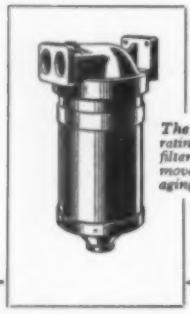
Agents in Spain: Senor Ramon Escario, Nunez de Balboa, 29, MADRID.

Agents in Egypt and Syria: T. G. Mapplebeck, 48, Sharia Abdel-Khalek Sarwat Pasha, CAIRO, Egypt.

Agents in Israel: Curt Israel, P.O.B. 3133, TEL AVIV

Out in front...





The 99.9% efficiency rating of VOKES filters ensures the removal of ALL damaging particle sizes.

Vokes aircraft filtration

With over 30 years of experience behind them in the design of all kinds of filters, Vokes are the acknowledged leaders in the world of scientific filtration. In the aircraft industry especially, Vokes have shown outstanding enterprise and have pioneered most of the modern innovations in airborne filtration.

AIR, FUEL, LUBRICATING and HYDRAULIC OIL FILTERS · CABIN PRESSURISATION FILTERS and SILENCERS · TEST-BED FILTER

VOKES *pioneers of scientific filtration*

VOKES LIMITED · GUILDFORD · SURREY · ENGLAND · London Office: 123 Victoria Street, Westminster, S.W.1

Vokes (Canada) Ltd., Toronto

REPRESENTED THROUGHOUT THE WORLD

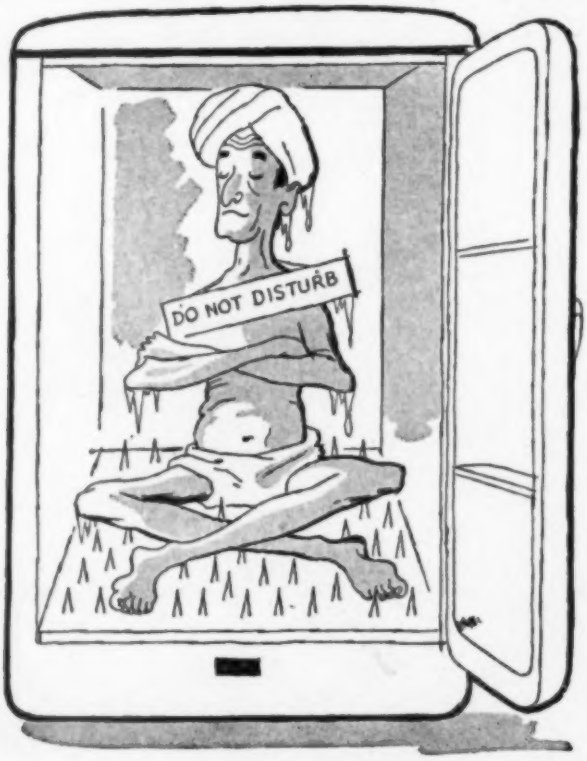
Vokes Australia Pty. Ltd., Sydney

V180A

Cold Comfort....

Extreme cold. A comfort to know that the safety factor of Triplex pressure windows actually increases as the temperature falls. Right down to —60°C.

Safe as (Triplex glass) houses, you might say. Most aircraft manufacturers *do*!



Fit "TripleX" and Be Safe

T.A.10

TRIPLEX SAFETY GLASS CO. LTD., 1 ALBEMARLE STREET, PICCADILLY, LONDON, W.1

THE HANDLEY PAGE HERALD

WHEREVER THE HERALD GOES

Rists Cables will be there

All cables used for instrumentation
on the Herald are of our manufacture

RISTS

RISTS WIRES & CABLES LTD
LOWER MILEHOUSE LANE • NEWCASTLE • STAFFS.

WILSON

OF LONDON

for

Aluminium

and

Alloys

A·I·D & A·R·B
APPROVED STOCKISTS

W · WILSON & SONS (LONDON) LTD

Registered Office and Works
114 Nightingale Road London N.22
Tel. BOWes Park 8431/6

And now an even *closer* look

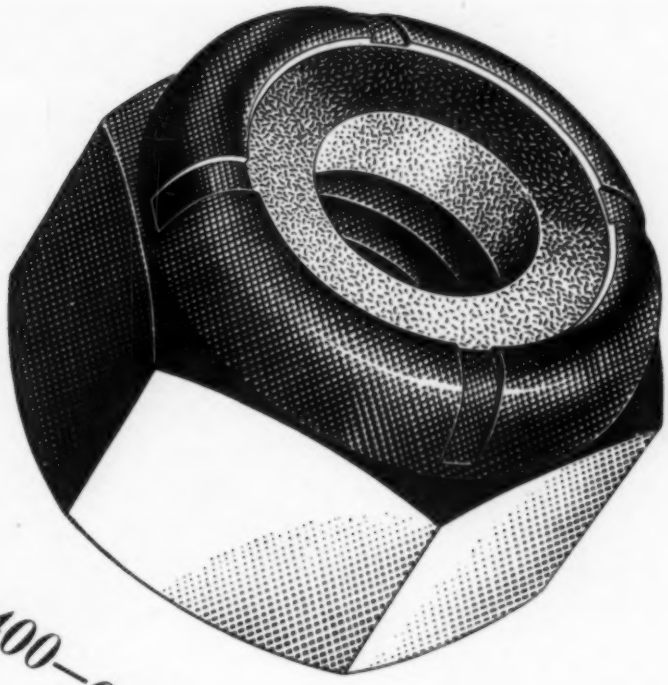
Complete appraisal of the Show in today's . . .

The Autocar

A final tour of the Motor Show—this time in your armchair! Expert comment on 1957 design trends and a superb array of photographs and drawings in The Autocar's magnificent Show Review give you a *closer* look at the new cars, caravans and accessories. Buy your copy today!

SHOW REVIEW

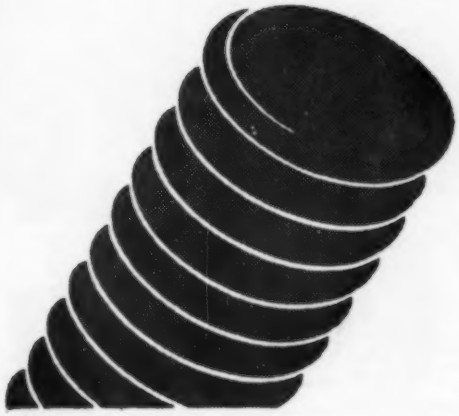
From all newsagents · 1s. as usual



...399...400—and how's the torque?

FINE! This Nyloc has been on and off a standard bolt 400 times—but its torque value is still well above the requirements of Stiffnut specification A.D. 114. Use it over and over again, the Nyloc stays tenacious. Why? Because the nylon insert moulds itself round the bolt to take up thread tolerance and defy the loosening effect of vibration.

Nyloc Stiffnuts of U.N.F. hexagon and anchor types, in addition to the A.G.S. 2,000 series, are now approved by S.A.E. Department of the Ministry of Supply.



Nyloc Stiffnuts

Enquiries to: **SIMMONDS AEROCESSORIES LTD**

BYRON HOUSE, 7-8-9, ST. JAMES'S ST., LONDON, S.W.1.

Head Office & Works: Treforest, Pontypridd, Glamorgan.

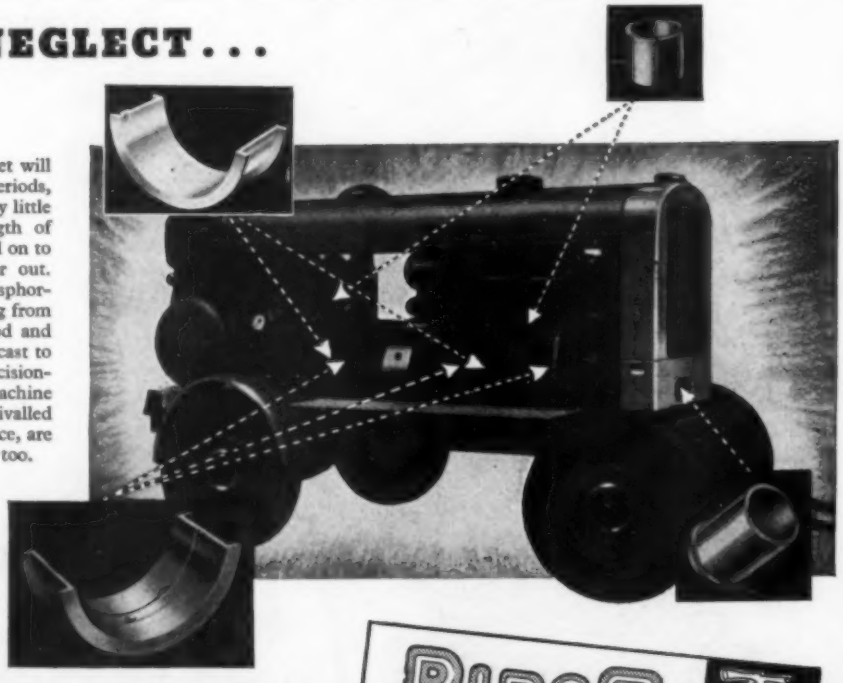
Branches: Birmingham, Manchester, Glasgow, Stockholm, Copenhagen, Ballarat, Sydney, Johannesburg, Amsterdam, Milan and New York.

A MEMBER OF THE FIRTH CLEVELAND GROUP

CBC 18A

interchangeability...
Build your own Actuator
and dispense with 'specials'.
The Western Universal Actuator
range enables you to specify your load,
stroke and speed requirements for linear or
rotary output Actuators. This will determine
which, of a range of standard motors, gearboxes and
output drives, you will require. These are assembled and
you have a Western Universal Actuator tailored to your needs.
WESTERN MANUFACTURING (Reading) LTD
THE AERODROME · READING · BERKSHIRE
Telephone: SONNING 2331
Grams: HAWK, READING

USED TO NEGLECT...



This twin cylinder diesel compressor set will have to work at full pressure for long periods, under arduous conditions and with very little attention. The accuracy and strength of BIRSO non-ferrous castings are relied on to give unfailing service year in, year out. Illustrated are some of the BIRSO phosphor-bronze castings used in the set, ranging from main bearing shells to connecting rod and starting-handle bushes. They are all cast to the same exacting specifications and precision-machined in our own extensive machine shops. Our great experience and unrivalled resources, coupled with a *personal* service, are available to help solve *your* problems too.

Castings from a few ounces to 10 tons in phosphor-bronze, gun-metal, aluminium-bronze, manganese-bronze and light alloys. Precision-machined bushes and bearings. Specialists in high-tensile aluminium-bronze castings, centrifugal-cast wheel blanks, and chill-cast rods and tubes.

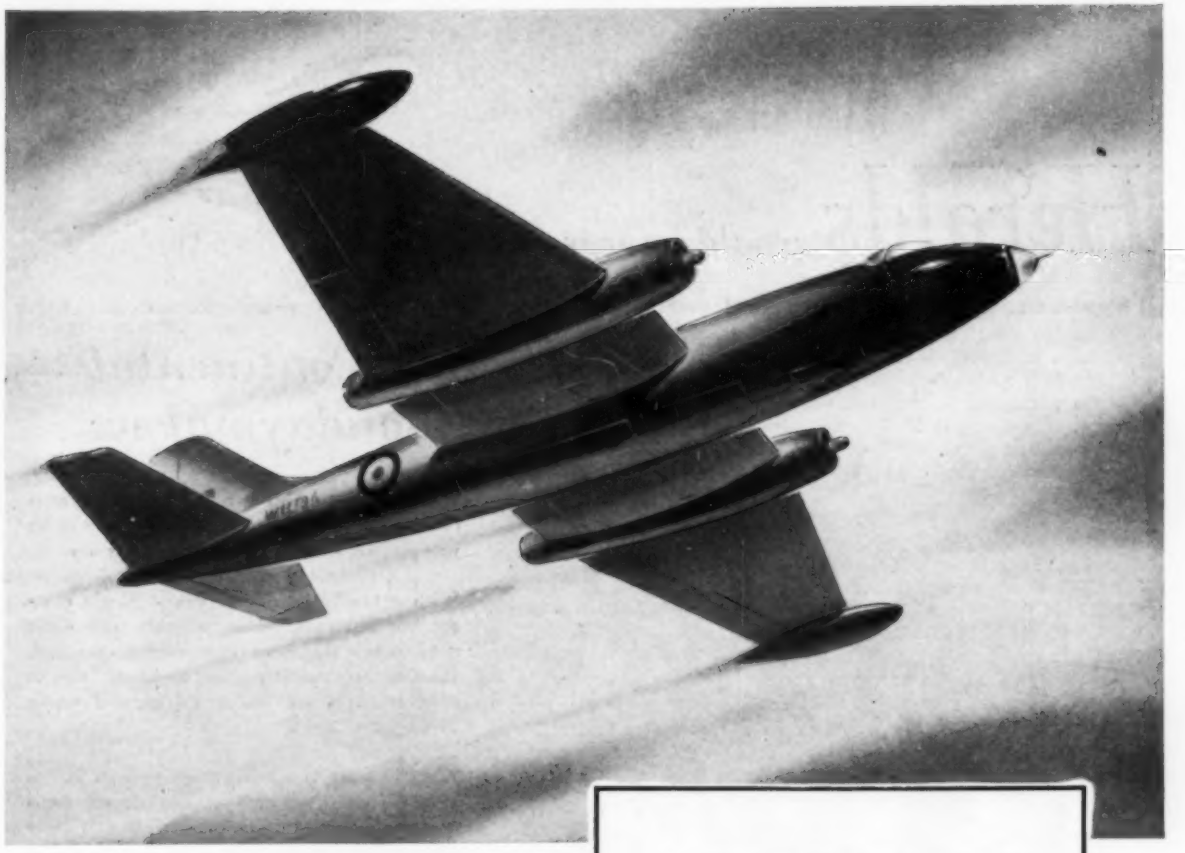
T. M. BIRKETT, BILLINGTON & NEWTON LIMITED

HANLEY AND LONGPORT, STOKE-ON-TRENT.

BIRSO TRADE MARK BN

Head Office: HANLEY—*Phone:* Stoke-on-Trent 22184-5-6-7 LONGPORT FOUNDRY—*Phone:* Stoke-on-Trent 87303

One of Britain's Largest NON-FERROUS Foundries



VERNONS

OF LIVERPOOL

Specialists in the design and production of ground-servicing equipment.

Latest addition to our wide range of high-performance machines is the GS 22 Starting and Servicing Set, which gives a peak output of 80 KW, providing sufficient power for starting the latest and largest types of aircraft engines. Its compactness ensures utmost economy in power production.

If you have a problem in the supply of special-purpose machines, we shall be delighted to have the details

VERNONS INDUSTRIES LIMITED KIRKBY INDUSTRIAL ESTATE LIVERPOOL · TEL: SIMONSWOOD 3261

Heralds *would improve the picture*

for Continental holidaymakers

When he went on his own, a holiday in Europe could be a fairly cheap affair, especially as he was prepared to rough it where necessary.

With a family it isn't so easy. Bigger costs are the first snag. Also, suitable resorts are not always the most conveniently reached. Comfort becomes important and long train or road journeys are recognised as well worth avoiding.

Air transport is already showing how it can give the complete answer. But the service is a very specialised one. It requires extremely economical airliners with a good standard of comfort. They must be able to deliver passengers on the doorstep—not at a mainline airport miles from the address on the luggage labels.

Heralds will be able to do this job better than any other aircraft. They will be robust, comfortable and very cheap to operate.

They will be able to use the smaller airfields on both sides of the Channel and thus serve those who only need them as airborne ferry-boats to the nearer French beaches. They will also have the speed, range and pressurised comfort to provide a cheap and practical service to holiday places all over Europe.

for 9 *good reasons*

- **Safety: four-engined assurance with full load.**
- **Reliability: strongly and simply built for long life and easy maintenance.**
- **Performance: meets world-wide flight requirements with a clear margin in hand.**
- **Payload: carries 44 passengers and their luggage.**
- **Economy: costs less than 1¼d. a passenger-mile to run.**
- **Small airfields: can take-off with full payload from 1,000-yard unpaved landing-strips up to 5,000 feet.**
- **Cruising speed: 221 m.p.h.**
- **Pressurisation: efficient and comfortable travel up to 20,000 ft.**
- **High wing: easy loading and a good view for passengers.**

HANDLEY PAGE RADLETT · LONDON · READING

FIRST AERONAUTICAL WEEKLY IN THE WORLD FOUNDED 1909

FLIGHT
and
AIRCRAFT ENGINEER No 2492 Vol 70 FRIDAY 26 OCTOBER 1956

Editor
MAURICE A. SMITH D.F.C. and BAR

Associate Editor
H. F. KING M.B.E.

Technical Editor
W. T. GUNSTON

Production Editor
ROY CASEY

Iliffe and Sons Ltd
Dorset House
Stamford Street
London, S.E.1
Telephone · Waterloo 3333 (60 lines)

BRANCH OFFICES

Coventry
8-10 Corporation Street
Telephone · Coventry 5210

Birmingham 2
King Edward House, New Street
Telephone · Midland 7191 (7 lines)

Manchester 3
260 Deansgate
Telephone · Blackfriars 4412 (3 lines)
Deansgate 3595 (2 lines)

Glasgow C.2
26B Renfield Street
Telephone · Central 1265 (2 lines)

Toronto 1, Ontario
67 Yonge Street
Telephone · Empire 6-0873

New York 6, N.Y.
111 Broadway
Telephone · Digby 9-1197

SUBSCRIPTION RATES
Home and Overseas · Twelve Months, £4 10s. U.S.A. and Canada, $14.00

In this issue

666 Handling the E.P.9
669 Mr. Canary's Snipe
670 Swedish Dragons
672 Test Teams
674 Good-bye to the Lanc
676 Piper Calls 1957 Tune
677 Orion
683 The Importance of Time
687 Aspects of the Agricola

Case for the Defence

LECTURING recently to the Royal Aeronautical Society (as reported on pages 683-685) A. Cdre. Rodwell Banks delivered himself of some very forthright opinions on the flying equipment of the Royal Air Force and on current methods of providing it. His strictures provoked an immediate reaction from Mr. Nigel Birch, Secretary of State for Air, who in a speech next day (see page 664) seized in particular on certain comparisons which the air commodore had drawn between the R.A.F. and the air forces of other countries, among which he had mentioned Sweden.

Though deploring the Minister's denigratory use of the phrase "employee of an aircraft company" in referring to a director of one of the industry's greatest firms (and a man of the highest technological and administrative capabilities) we feel that, by and large, the case for the defence is the stronger. Two years ago the prosecution would have been on firmer ground. As *Flight* said in June 1954, ". . . in the intercepter class it must be recognized that only a most gratifying influx of Canadair-built Sabres has raised our own nation to something like parity with Sweden."

Since that time the R.A.F. has been largely re-equipped with the Hawker Hunter, a type which is also being purchased (to the tune of 140 aircraft) by the Swedes themselves. As Mr. Maudling, Minister of Supply, said in a speech last Saturday, "The best test of the efficiency of an industry is what it can sell in competitive export markets, and by this test the aircraft industry shows up very well indeed."

Undoubtedly A. Cdre. Banks had in mind Sweden's excellent Saab Lansen attack aircraft and—subject of a pictorial feature in this issue—Draken fighter.

Terminological Inexactitudes

AS a race, engineers and technologists are certainly no less articulate than their fellows, and many have the great gift of being able to convey, in speech or writing, exactly what is in their mind. Even the latter, however, are unavoidably handicapped by the limitations of the aeronautical vocabulary.

One of the classic examples of unnecessary difficulty of this kind is the distinction which has frequently been drawn between "airscrew" and "propeller." Although the earlier science of marine propulsion provided no basis for so doing, it was for long the custom of governments, air forces and, at times, the majority of people connected with aviation, to restrict the use of the term "propeller" to a device mounted *behind* an engine to push the aircraft along—like a ship's screw.

There was an almost certainly apocryphal story of an Air Ministry telegram to America, which, urgently demanding 12 airscrews, lost an "s" in transmission and produced 36 eager young pilots, navigators and gunners. Whether or not such risks of confusion are real, tractor propellers are still widely referred to as airscrews. We ourselves have subscribed to this practice for nearly half a century, but in this issue we depart from it, partly because the word is never used in America (where *Flight* has a large circulation), but principally because there is no real reason for the existence of two separate words to describe the same object.

One can cite many other examples of difficulties in the use of words, difficulties which could be cleared up overnight if there were an international authority competent to set a standard. If one picks up a glossary of aeronautical terms one is bidden to use the term "angle of incidence" only to describe the angle between a *pivoted* aerodynamic surface and the longitudinal axis of the aircraft or vehicle. Yet many aerodynamicists use the term to denote the angle of the incident airflow on a fixed surface, although this is supposed to be more correctly termed "angle of attack." Going further along the same path, we appreciate the use of "variable incidence" to describe the inlet vanes of a gas-turbine compressor but fail to see the difference between this type of arrangement and that employed in a propeller (or airscrew, if one is a diehard), in which the term "variable pitch" is universal. Rationalization in aeronautics is frequently proposed as one of the panaceas to cure present ills. Where better to start, then, than in the vocabulary which we must use to convey our ideas?

CACCIATORE: The Hawker Hunter T.7 prototype at Rome's Ciampino Airport after its 566 m.p.h. trip from London Airport (news item on this page).

FROM ALL QUARTERS

Higher Appointments

IMPORTANT new appointments are announced as we go to press.

The Ministry of Supply and the Air Ministry announce that, with the Queen's consent, the Minister of Supply has appointed Air Marshal Sir Claude Pelly, K.C.B., C.B.E., M.C., as Controller of Aircraft at the Ministry of Supply with effect from November 19, 1956. He will succeed Air Chief Marshal Sir John W. Baker, G.B.E. K.C.B., M.C., D.F.C., A.D.C., who will be retiring from the Service towards the end of the year.

Air Marshal Pelly, who is 54, was Senior Air Staff Officer at Air Headquarters, Western Desert, in 1943, and commanded the M.o.S. Aeroplane and Armament Experimental Establishment from 1946 to 1948. In 1953 he was appointed C-in-C. Middle East Air Force.

The Air Ministry announces that the Queen has approved the appointment of Air Marshal Geoffrey William Tuttle, C.B., O.B.E., D.F.C., as Deputy Chief of the Air Staff. Air Marshal Tuttle's appointment as Deputy Chief of the Air Staff in an acting capacity was announced on July 12 last.

It is also announced that the Minister of Supply has appointed Dr. R. Cockburn, C.B., O.B.E., to the post of Controller of Guided Weapons and Electronics with effect from October 17, 1956.

The Minister of Supply has further, with the agreement of the First Lord of the Admiralty, appointed Rear-Admiral A. S. Bolt, D.S.O., D.S.C., to be Deputy Controller of Aircraft in succession to Vice-Admiral W. T. Couchman, C.B., C.V.O., D.S.O., O.B.E. Rear-Admiral Bolt will take up this appointment in the spring of 1957.

Hunter at Ciampino —

ON its way to Italy, for its qualities to be demonstrated to the Italian Air Force, a Hawker Hunter T.7 gave an impressive demonstration of its capabilities by setting up—subject to confirmation—a new record for the flight from London to Rome. The T.7, flown by A. W. ("Bill") Bedford, Hawker deputy chief test pilot, and Frank Murphy, now R.A.F. liaison officer and formerly production test pilot at Dunsfold, covered the 891.67 miles on October 20 in 1 hr 34 min 28.5 sec, an average speed of 566.1 m.p.h. The existing London-Rome record, 1 hr 59 min, was set up by a de Havilland Comet I on March 16, 1950.

— and Hunters at Amman

THE arrival of two R.A.F. Hunters from Cyprus at Amman on October 18 raised speculations that the Venoms already in Jordan under treaty arrangements were to be reinforced by more modern fighters, especially as two days previously Major General Ali Abu Nuwar, chief of the Jordanian general staff, said that the R.A.F. aircraft at Amman had been "put on the alert" to aid Jordan in the event of an Israeli attack.

"Flight" photograph

But a British Embassy spokesman in Amman was reported as saying that the Hunters—the first swept-wing fighters ever seen over the Jordan capital—were on "visiting flights," in accordance with the practice of acquainting pilots with airfields and operating conditions, and that they would stay for only brief periods. He indicated that other Hunters would be making similar visits.

In London an Air Ministry spokesman said that the aircraft were on "a normal training flight through various Middle East stations, which include Amman."

New Chief Designer at Reading

FOLLOWING the recent resignation of Mr. E. W. J. Gray, B.Sc., M.I.Mech.E., F.R.Ae.S., Mr. J. Allan, Dip.Ae. (Hull), A.F.R.Ae.S., has been appointed chief designer of Handley Page (Reading), Ltd. After being apprenticed to the Blackburn Aeroplane and Motor Company (as it then was) Mr. Allan became a member of the design staff, and between 1937 and 1952 worked both as a stressman and as an aerodynamicist. While at Blackburns he was responsible for much of the design work on the H.P.88 research aircraft. In 1952 he joined Handley Page (Reading), Ltd., as assistant chief designer, taking responsibility for military and civil versions of the Marathon transport, and subsequently for design development of the Herald since May, 1955. Mr. Allan is 40 years of age.

Mr. Allan.

Air Minister's Reply to Critics

IN a speech at Stockton-on-Tees on October 18 the Secretary of State for Air, Mr. Nigel Birch, O.B.E., M.P., said that there had been "much loose and some dangerous talk lately about the state of readiness of our Armed Forces and about their equipment." Referring particularly to air power, Mr. Birch commented:—

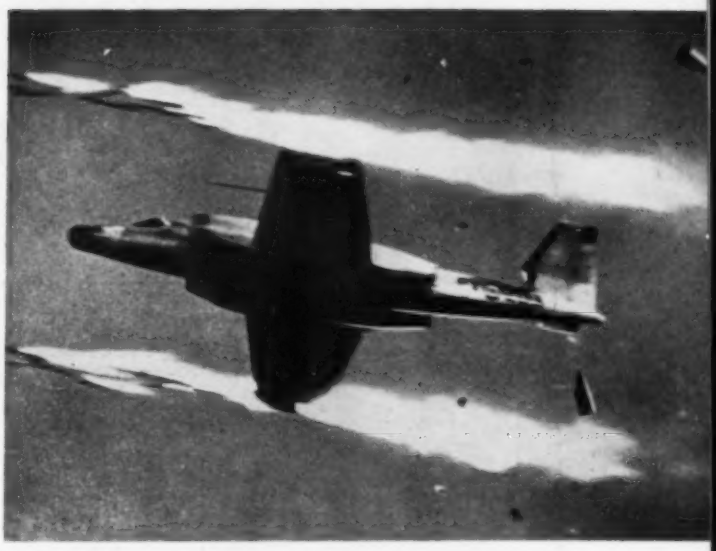
"I see that an employee of an aircraft company said yesterday that Britain was worse equipped in the air than America, Russia or even Sweden. The supreme test of air power today is the possession of 'V' class types of bombers. Except in extremely long range, which we do not need, I believe that our 'V' bombers have a better performance in speed, height over target and manœuvrability than their U.S. and Russian equivalents. The Swedes have no medium or heavy bombers. Moreover the Swedes are busy buying our Hunter fighters, which hardly looks as if they share the black views of some people here at home.

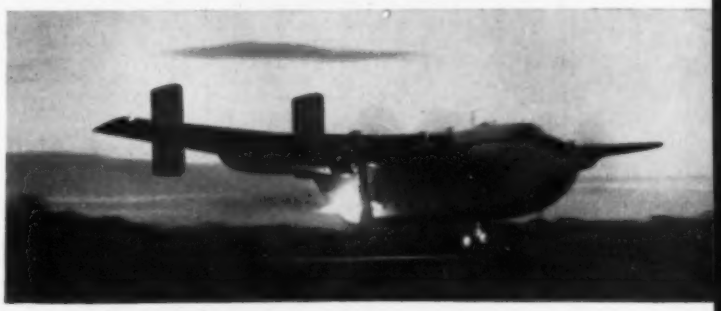
"The main difficulty in maintaining a front rank Air Force not only today but for the future is the long time scale for development and the great cost of development and of the new machines themselves.

"It is therefore vital to choose rightly and develop quickly. Our procedures have been much improved since 1952. But this is a continuing process and I certainly intend to bend all my efforts to getting them better still.

"Meanwhile I trust that critics among manufacturers will use their best efforts and energies in getting their development and production ready on time."

ROYALLY RECEIVED by H.E. Baha Ud-din Toukan, the Jordanian Ambassador, on behalf of King Hussein: the Vickers Varsity VK 501, converted by Eagle Aircraft Services, Ltd., whose chairman, Mr. Harold Bamberg, is seen (right) formally handing-over the aircraft to the Ambassador at Blackbushe on October 18. With them (left) is the Jordanian Military and Air Attaché, Col. Karim Oham.





***BROCK'S BENEFIT** performances by notable and contrasting aircraft. Right, an Avro Aircraft CF-100 shoots the works from its wing-tip Mighty Mouse pods. Below, twenty minutes after sunset, a Blackburn Beverley, with five Scarab rockets each side, gets airborne.*

At St. Leonards, Sussex, last Saturday the Minister of Supply, Mr. Reginald Maudling, said that against the disappointments and difficulties encountered by Britain's aircraft industry could be set "a magnificent record of achievement." He would like its supporters to let its achievements speak for themselves, and to critics would say: "Stop knocking the aircraft industry around, because you are doing no good to the country or to the many thousands of your fellow-citizens who work to design and build British aircraft."

Mr. Maudling said it was true "our present generation of fighters has been taking too long to get into effective service. We lost years of progress when, shortly after the war, the Government of the day decided not to go ahead with manned supersonic flight. It is very difficult to catch up once you have slipped back."

In the civil field, he added, "we have a real chance of regaining the position we held before the Comet disasters. I do not think it is always realized what a great triumph it was when the Viscount broke into the American domestic market."

[A. Cdre. F. R. Banks' lecture to the Royal Aeronautical Society is reported on pp. 683-5; editorial comment, p. 663.]

V-A Military Aircraft Specialists

THE formation of a new department, to be known as the military aircraft office, is announced by Vickers-Armstrongs (Aircraft), Ltd. Situated at Weybridge, it will serve the whole aircraft company, including the Supermarine works. In charge is Mr. Jeffrey Quill, O.B.E., A.F.C., formerly Supermarine sales and liaison manager; he will be assisted by G/C. R. J. Carvell, R.A.F. (Ret.), who recently joined the company, and by Mr. M. Scott Mackirdy, a member of Mr. Quill's staff at Supermarine since 1950. They will analyse military aircraft requirements at home and in Commonwealth and foreign countries; maintain contact with the appropriate air staffs; and study markets and promote sales.

Mr. Jeffrey Quill.

G/C. R. J. Carvell.

As senior test pilot for Supermarine from 1938-47, Mr. Quill was primarily responsible for the flight testing of Spitfires from the prototype stage onwards. During the war he flew operationally in the R.A.F. and also served in the Fleet Air Arm.

G/C. Carvell was commissioned in the R.A.F. in 1926. He was transferred to the Technical Branch in 1941, and from 1946 to 1949 served as M.o.S. representative in Australia. After three years at Coastal Command H.Q. he was appointed Assistant Commandant of No. 1 School of Technical Training, Halton, where he remained until his retirement this year.

Mr. Scott Mackirdy has been with Vickers-Armstrongs since 1945. After service in the R.A.F. and F.A.A. in pre-war days he was invalided out. A few years later, although still officially unfit for aircrew duties, he flew all types of aircraft in the A.T.A., from 1941 to 1945.

Routine Ejection Demonstration

LAST Friday, at Chalgrove airfield, Bucks, Warrant Officer M. Tournier of the French Air Force made a test ejection in a Martin-Baker Mk 4 seat from a Meteor 7/8 at 420 kt E.A.S. at 1,500ft. The ejection was part of a routine demonstration designed mainly to gain experience of the physiological effects of escape at high speeds. The seat and parachutes worked perfectly and Tournier received only minor abrasions. The Meteor was piloted by Capt. Scott, Martin-Baker test pilot. This was, incidentally, the fastest test ejection so far carried out, although emergency ejections have been made at rather higher speed. For Tournier it was his 600th parachute descent but his first ejection.

Tribute to Sir Richard

MORE than 1,000 people attended the memorial service to Sir Richard Fairey at St. Martin-in-the-Fields, London, on October 19. Giving the address, Lord Brabazon, a lifelong friend of Sir Richard, said of him:—

"Enthusiasm, concentration, independence and originality were his, whatever he was doing. He was a pioneer in the early days and he was a pioneer right to the end. The world speed record by his firm made him very proud.

"There was nothing he touched that he did not adorn and embellish. Under that serious appearance he was basically shy, but he had the charm of the eternal boy who never really grew up."

The lesson was read by another great friend of Sir Richard, Vice-Admiral Sir Caspar John, Flag Officer, Air (Home) and son of Augustus John, the artist. Also among those present were Air Chief Marshal Sir Ronald Ivelaw-Chapman, Vice-Chief of the Air Staff, representing the Air Council, and Mr. Reginald Maudling, Minister of Supply. [An obituary of Sir Richard appeared in our issue for October 5.]

Lawrence D. Bell

FOUNDER of the Bell Aircraft Corporation, of Buffalo, N.Y., Mr. Lawrence Dale Bell died in that city last Saturday at the age of 62.

He had worked his way through the aircraft industry, for he started as a mechanic in 1911. He subsequently acted as superintendent and, finally, vice-president and general manager for Glenn L. Martin between 1913 and 1928, and then held similar posts with Consolidated until 1935.

In the latter year he formed the Bell Aircraft Corporation, which has since made a speciality of high-performance, single-seat machines. Bell were assigned the task of designing America's first jet aircraft, the P-59 Airacomet; but the company's greatest achievement was probably the X-1 rocket-propelled research aircraft, which in 1947 became the first piloted supersonic aeroplane and reached a speed of 967 m.p.h. Later developments of the same basic design reached almost twice this speed, and the more advanced X-2 is reported to have reached an altitude of 126,000ft and a speed of 2,200 m.p.h., or more than Mach 3.

At Fort Worth, Texas, Bell maintain an enormous production of helicopters, and at other locations the company are leaders in the design, development and production of advanced types of rocket motor. Bell are also prime contractors for the GAM-63 Rascal air-launched bombardment weapon.

HANDLING THE E.P.9

Edgar Percival's Agricultural and Bush-flying Aircraft

By C. M. LAMBERT

LAST week I went to the Edgar Percival Aircraft, Ltd., factory at Stapleford Tawney Airfield, Essex, talked with Mr. Edgar Percival, looked at E.P.9 production and flew the first prototype G-AOFU.

The E.P.9, which still has no name, is being built in batches of ten, and the first batch is now in recognizable form in the works. Material is on hand for some 50 machines and most of the fabricated components for the second ten are ready. The first completed production machine has been packed and dispatched to New Zealand.

It is remarkable that production aircraft differ hardly at all from the prototype. Main innovations are that toe brakes are substituted for a ratchet hand lever; the cockpit instruments are slightly rearranged; and engine cowling panels and rear-loading door have been redesigned so that most panels have only single as opposed to double curvature. The latter change brings obvious savings in production and repair. As foreshadowed some time ago, the tailwheel suspension has been changed from rubber in tension to rubber in compression, improving efficiency and simplicity.

The E.P.9 is offered not only for agricultural work, but also for supply dropping, ambulance, passenger and freight duties, communications, photography and geophysical survey. It can operate from short strips, has a freight cabin volume of 185 cu ft, and can carry six people and baggage, including pilot. It has a cruising speed of 128 m.p.h. and can lift a maximum useful load of 2,190 lb. Access to the rear cabin is by a door to port or through the clam-shell door under the tail. Standard 44 gal petrol drums can be rolled straight in at the back.

The wing is metal covered, as are flaps and ailerons. Steel tubing and fabric covering have been used for the fuselage. Main and tail undercarriage legs have rubber disc shock absorbers with Ferodo snubbers for damping. The hydraulic disc brakes at the main wheels take care of steering, the tailwheel having only a light centering spring. The engine is a Lycoming GO-480-B1B geared, unsupercharged unit driving a Hartzell metal, two-bladed, constant speed propeller. Take-off power is 270 h.p.

The two-place cockpit is located very high up, ahead of the wing leading edge and almost clear of the top of the engine. The windscreen is therefore extremely large and affords superb visibility. Two extra small windows above the wing root give very good visibility over the wing during turns in either direction. Neither seat nor rudder pedals are adjustable in the prototype, but the position and cushioning is comfortable. Only lap straps are provided. Flying controls are fully duplicated and the instrumentation, including basic blind-flying instruments, is clearly visible from both sides. Flap, brake, fuel hand-pump, primer and engine control levers are between the pilots. Two metal tanks in the wing roots hold a total of 56 Imp. gal. Battery and generator, with electric starter, are standard equipment. Flaps and ailerons are slotted, the former being mechanically actuated by a three-position lever, and the ailerons droop automatically to 15 deg when flaps reach 30 deg deflection.

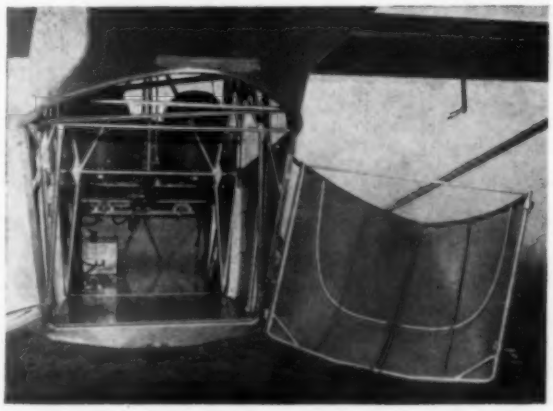
I flew first with Mr. Percival. The turn-and-bank indicator had been removed, but he nevertheless carried out some perfect cloud-flying without instruments, while trying unsuccessfully to get above the lowish cloud then prevailing. After ten minutes we landed again and I took over, flying from the right-hand seat because I like a left-hand throttle. Visibility was then something over a mile and cloud-base was down to 700ft. I had a one-third fuel load and 3½ cwt of gravel in the back. The c.g. was at the 27 per cent mid-setting.

The engine was very smooth indeed and noise level was not excessive. Throttle and propeller-pitch control response were admirably precise. Taxying, using bursts of throttle to initiate turns and brake to straighten up, was simple. Some difficulty I experienced in turning on very wet grass was traced to a sticky tailwheel swivel. This part is different in production aircraft. Ample braking power was available and the ride on the ground was smooth. Undercarriage track is no less than 10ft 10in.

I found the handling characteristics of the E.P.9 in the air very good indeed. Visibility, as stated before, was superb, with a relatively small blind area directly astern. The engine is mounted on the fore-and-aft axis, being tilted neither downwards nor to one side, and the wing, of 12 per cent thickness/cord ratio, is quite thin; overall drag appears to be low. Trim changes caused by variation in power setting were negligible. Control forces remained remarkably constant over the whole speed range which I tried (40 m.p.h. to 125 m.p.h.) and never became excessive. The three controls were well harmonized, with the exception that the ailerons became heavy at large deflections. This has been cured in production aircraft by re-arranging the aileron gearing.

Take-off was simple. Rudder became effective soon after opening the throttle and the E.P.9 got airborne cleanly without particularly wanting to have its tail raised. Unstick speed was very low, acceleration quick and the ensuing climb most satisfyingly steep. For take-off I used the recommended setting of 30 deg flap (ailerons drooped) and set the trim lever in the roof two-thirds forward. The trim lever had, I found, its own friction nut. Though 30 deg of flap are normal for take-off, the best climb is achieved with the 10 deg setting, and this can be selected after take-off with no noticeable sink. The trim change is firmly, but not heavily, nose down. Maximum engine r.p.m. are 3,400, a normal climb setting being 3,000 r.p.m. and $-2\frac{1}{2}$ lb intake pressure.

I tried the aircraft first at 95 m.p.h. with 2,900 r.p.m. and -7 lb. It appeared to be somewhat more stable laterally than directionally so that, with hands off, rudder application caused plenty of yaw without very much bank. With feet off, successive reversal of bank resulted in some yawing away from the direction of change of bank. This was not pronounced, however, and Mr. Percival told me it is possible to initiate a co-ordinated turn with aileron alone. From a trimmed condition at 95 m.p.h. I pulled the nose about 15 deg up and let go of the stick. Very slowly the nose dropped again after the speed had fallen off about 10 m.p.h. For a while the aircraft continued in a very gentle dive, and then, after gaining about 15 m.p.h., it made a positive recovery to the



The Percival E.P.9 has an ample freight hold, as can be seen from these two views. Above, the clam-shell door is open to show the freight floor reaching forward to the engine bulkhead. A man may stand upright in the cabin.

"Flight" photographs

"Flight" photograph

Superb visibility, excellent handling, simplicity and all-round utility are features of the E.P.9.

trimmed attitude and started a second very faint oscillation. Such a shallow oscillation was most pleasing since the cloud base was by then down to 500ft.

I tried throttling back firmly. The nose fell if not restrained; and when I held it up the force increased smoothly and gently and the speed fell back slowly. Conversely, when I opened the throttle to full power, there was no immediate change of trim, and the nose had to be held down only in relation to the increase in speed, as opposed to increase in power. In either case the final stick forces were most pleasantly light. The trim control was in both cases very effective and positive in relieving what forces there were.

From this series of tests I opened up to full power and let the speed build up. It was still increasing smartly at 125 m.p.h. I.A.S., but the feel of the aircraft was virtually unchanged and the stick forces were almost the same. The total trim change between 95 m.p.h. and 125 m.p.h. did not require immediate trimming and could be held perfectly comfortably. The visibility was now down to about three quarters of a mile and it had started to rain a little so I soon slowed down as I did not know the area and could not afford even momentarily to lose sight of the stream which was my only landmark. For navigation the E.P.9 carries an E.2A compass.

I went through the full cycle of flap extension and retraction. Application of 10 deg gave a slight nose-up trim change. When this was increased to 30 deg, the nose came firmly up, but the final setting caused no further trim change at all—a most useful feature for short final approaches in bad weather when a trim change close to touch-down can be annoying. I found sufficient trim range available to cope with all settings.

At 500ft, as it now was, the ceiling was obviously too low to contemplate stalling trials; but at 700ft during our flight together, Mr. Percival had shown me a gentle stall. The nose had not dropped violently, nor had a wing gone down. With two people up and the ballast load, the speed had been about 35 to 40 m.p.h. The stall was heralded by gentle buffeting.

My first circuit for landing I made at 400ft, staying just outside the airfield boundary on the downwind leg. I applied 30 deg of flap, trimmed, and picked out a clump of trees as my final turning point, since the airfield was out of sight when I got to the end of the downwind leg. On base leg I lowered full flap and throttled gently back. The rate of descent increased smoothly as the throttle was closed and I headed in for the touchdown. Since the engine is mounted so unusually far below eye-level I got the impression that I was aiming for the beginning of the runway. I was rather annoyed then to glide into the middle of the field without touching down and have to go round again. This I did, being once again greatly impressed by the E.P.9's excellent behaviour during large variations in power.

The very low nose gives the impression of a steep approach when the actual rate of descent is not excessive. Side-slipping is very effective, but the usual straight-in approach is not more than normally steep. I was somewhat hampered by weather now. The visibility in the air was down to little over half a mile in slight rain, and the cloud base was right down to 400ft. I made another circuit, picking a turning-in point slightly further out, and arrived on three points with lots of elevator control in hand on the edge of the field. The approach speed was just under 60 m.p.h., though about 50 m.p.h. apparently gives a slightly higher rate of descent. The undercarriage absorbs shocks extremely well, though one can feel that the suspension is bungy and not hydraulic. At maximum weight it is reported to be extremely effective. The stick does not have to be held hard against the stomach. In fact, at no point did I find any part of me getting in the way of a stick movement.

I took off again since I wanted to confirm my opinion of the circuit. But the weather conditions were by then so unfavourable, that I made haste to get back on to the ground and started a final bad weather circuit. I could just see the airfield from the base leg and, had the E.P.9's windscreen not afforded such excellent visibility, I should have had much more trouble than I in fact did. Rain had partly obscured the central portion of it, but the deeply curved sides extending well below the pilot's knee level, were completely clear. The landing was again most pleasant and simple.

My main impression of the E.P.9 is that it has classic handling qualities. It is absolutely straightforward to fly and not in the least tiring. Its cruising speed is creditable and useful, and yet its behaviour at the lowest speeds leaves nothing to be desired. It is very simple, having no systems worth worrying about. I suggested to Mr. Percival that, to make ground handling as comfortable as flying, some form of tailwheel steering might be an advantage, but it is not necessary. I was, and still am, most grateful for the E.P.9's excellent qualities in view of the weather at the time of my flight.

Principal data for the E.P.9, with normal category figures in brackets, are: span, 43ft 6in; length, 29ft 6in; height, 8ft 9in; gross weight, 4,140 lb (3,550 lb); empty weight, 1,950 lb (1,950 lb); useful load, 2,190 lb (1,600 lb); top speed, full power, 144 m.p.h. (146 m.p.h.); cruising speed, 126 m.p.h. (128 m.p.h.); rate of climb, 800ft/min (1,120ft/min); take-off in 5 m.p.h. wind, 175 yd (105 yd); landing speed, light, 37 m.p.h. Wing loading, at 3,550 lb, is 15.6 lb.

SWISS EQUIPMENT

THE second prototype of Switzerland's F.F.A. P-16 (now designated P-16-02) has been flying since May this year and achieved supersonic flight in a shallow dive on its seventeenth flight. Mid-1957 should see the delivery of four more P-16s with a more powerful turbojet than the present model of Armstrong Siddeley Sapphire. The P-16 is a single-seat fighter/bomber with exceptionally good take-off and landing characteristics, designed specifically for operation from Swiss terrain.

Present strength of the Swiss Air Force is 175 Vampire F.B.6s (75 British-built, 100 constructed in Switzerland with British Goblins), and 250 Venom F.B.1s and F.B.4s, all built in Switzerland. The Ghosts for the Venoms are also Swiss-built, and deliveries are still in progress. Mustangs and the Morane-like D-3801s are now used for training.

SUPER MYSTERE: (left) One of the pre-production Dassault Super Mystère B2s which have preceded the series-built aircraft at Mérignac.

SUPER MISSILE: (right) The Philco Sidewinder air-to-air guided missile, now operational in the Pacific and Mediterranean with U.S. Navy F9F fighters.

HERE AND THERE

Sir Frank Whittle Honoured

AT Philadelphia on October 17, A. Cdre. Sir Frank Whittle was awarded the Franklin Medal, highest honour of the Franklin Institute, for his "pioneer work in developing aircraft engines and high-speed flight." Mr. S. Wyman Rolph, president of the Institute, made the presentation.

F.D.2 in Lord Mayor's Show

ONE float in this year's Lord Mayor's Show, which is to be held on November 9 with "aluminium" as its theme, will carry a one-fifth scale model of the Fairey F.D.2.

D.H. Deputy Chairman

AT a recent meeting of the Board of the de Havilland Aircraft Co., Ltd., Mr. A. F. Burke (managing director) was appointed to the additional post of deputy chairman. A similar appointment has also been made by de Havilland Propellers, Ltd., the director in this case being Sir Ralph Sorley.

Soldiering On

THOUGH the R.A.F. has said farewell to its Lancasters (as recorded elsewhere in this issue), more than one aircraft of this type is still flying. At the College of Aeronautics, Cranfield, PA474 is on loan from the Ministry of Supply for research; and at Blackbushe NX739 is maintained for the Air Ministry by Eagle Aircraft Services, Ltd., and used extensively for air-to-air photography.

New Supersonic Simulator

CONTRACTS worth over £1m have been placed by the U.S.A.F. with Link Aviation, Inc., for a quantity of simulators for the Convair F-106A intercepter. The F-106 is the developed F-102 powered by a J75 turbojet with afterburner. Other simulators of supersonic aircraft for which Link hold contracts include those for the F-102A and the Navy's F11F, F8U and F5D.

Strange New Shapes

FOUR U.S.A.F. Vertol H-21s, the first twin-rotor helicopters to be so employed in this country, are to be based at Bovingdon, Herts, for air-sea rescue duties.

HELICOPTERS TODAY

NEXT week's issue of *Flight* will be an enlarged special issue devoted to the world's helicopters. All current types and their power units will be reviewed, and a critical article will examine rotorplane progress and forecast future possibilities. Our usual regular features will be included.

Australian Government Changes

CHANGES recently announced in the Australian Government include the appointment of Mr. F. M. Osborne as Minister for Air. Senator S. D. Paltridge, at present Minister for Shipping and Transport, is also to take over responsibility for civil aviation.

Dispute Negotiations

EMPLOYEES at the Woodford, Cheshire, factory of A. V. Roe and Co., Ltd., who have been on strike over pay rates, pending an agreed piece-work price, were due to meet in Stockport today (October 26) to hear a report from union leaders on talks with the employers instigated by the Ministry of Labour. Employees of the de Havilland Aircraft Co., Ltd., factories at Hatfield, Broughton, Portsmouth and Christchurch are due to meet in London tomorrow to discuss an application for uniform pay rates in all sections of the factories.

Bernt Balchen Retiring

THE first man to fly over the South Pole, Norwegian-born Colonel Bernt Balchen, 57, is to retire from the U.S.A.F. He was chief pilot to Admiral Byrd.

Car Show Review

OUR associated journal *The Autocar* publishes today (October 26) the last of its three special issues on the London Motor Show. Called "Show Review," this contains a full technical survey of design trends and a final appraisal of the principal exhibits. Its price is 1s as usual.

Flight Index

THE index for Vol. 69 of *Flight* (January to June 1956) is now available from Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1, price 1s (or by post, 1s 2d). Half-yearly volumes can be bound at a price of 24s, including case and index; or case and index are available separately, price 7s 6d (by post, 8s).

THE GOLD MEDAL of the Institute of Navigation has been awarded jointly to Messrs. W. J. O'Brien and Harvey F. Schwarz for their work in originating the Decca Navigator system. The president, Capt. A. M. A. Majendie, is seen making the presentation to Mr. O'Brien at the recent a.g.m., and in the second picture is Mr. Schwarz.

BRISTOL TO BELFAST: Seen on the right is Mr. Frank Kelly, who on November 1st becomes publicity officer to Short Bros. and Harland, Ltd. Since 1948 he has been press officer to the Bristol Aeroplane Co., whose organization he joined in 1938.

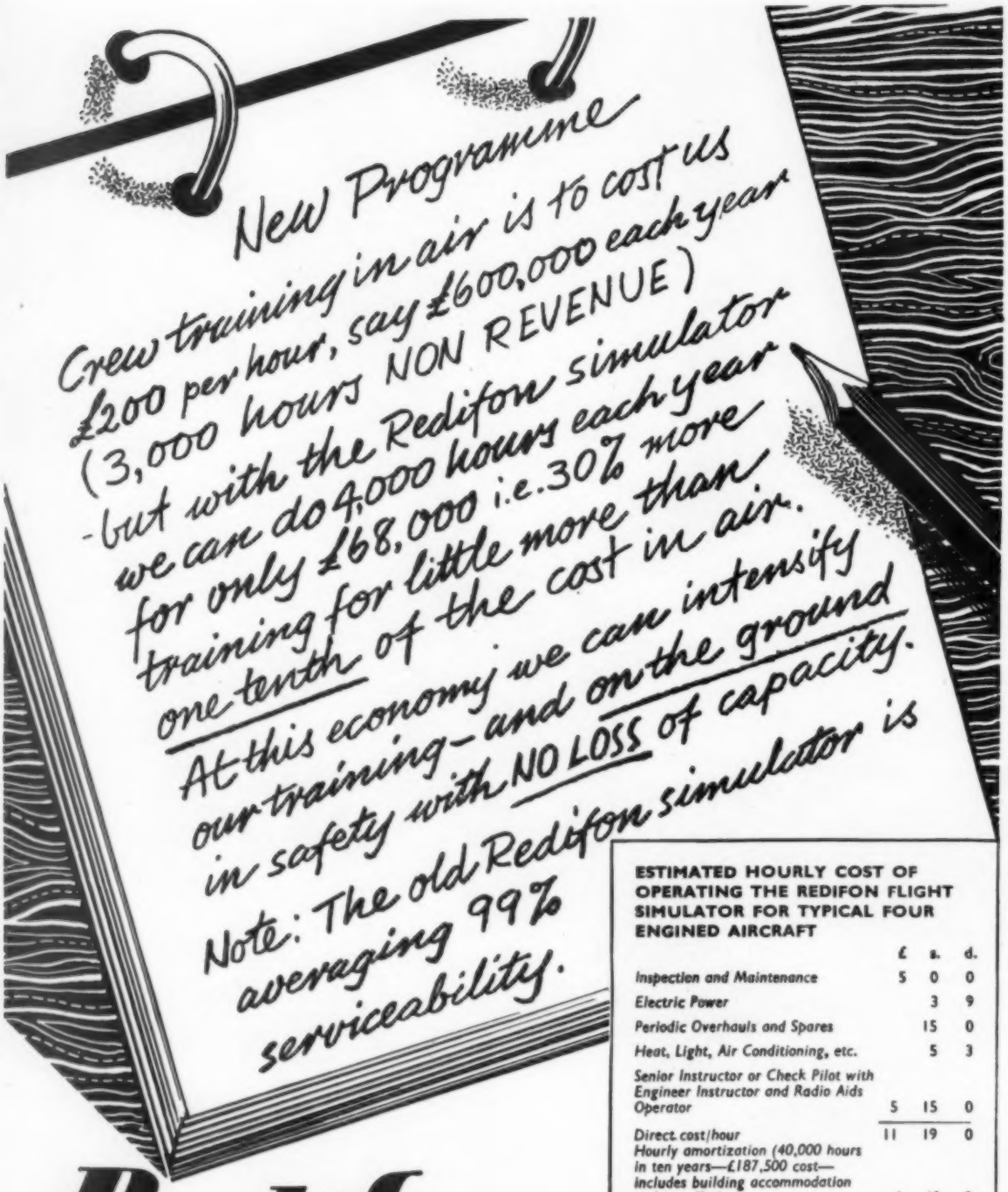
The Rotol design of propellers for turbo-prop engines has been proved in over 1,200,000 hours of airline operations and a wide field of military activity.

The development work which has made this possible continues unceasingly and new blade forms are now under examination to further improve efficiency and provide the most economical propeller for the higher powered engines now becoming available.

ROTOL

GLOUCESTER · ENGLAND

PUB/R/20/56



New Programme

Crew training in air is to cost us £200 per hour, say £600,000 each year (3,000 hours NON REVENUE)

- but with the Redifon simulator we can do 4,000 hours each year for only £68,000 i.e. 30% more training for little more than one tenth of the cost in air.

At this economy we can intensify our training - and on the ground in safety with NO LOSS of capacity.

Note: The old Redifon simulator is averaging 99% serviceability.

ESTIMATED HOURLY COST OF OPERATING THE REDIFON FLIGHT SIMULATOR FOR TYPICAL FOUR ENGINED AIRCRAFT

	£	s.	d.
Inspection and Maintenance	5	0	0
Electric Power		3	9
Periodic Overhauls and Spares		15	0
Heat, Light, Air Conditioning, etc.		5	3
Senior Instructor or Check Pilot with Engineer Instructor and Radio Aids Operator	5	15	0
Direct cost/hour	11	19	0
Hourly amortization (40,000 hours in ten years—£187,500 cost—includes building accommodation and installation)	4	13	9
Simulator cost/hour	£16	12	9

Redifon

FLIGHT SIMULATORS

Flight Simulator Division

REDIFON LIMITED · CRAWLEY · SUSSEX

A Manufacturing Company in the Rediffusion Group

Mr. Canary's Snipe

American Enthusiast Restores a British World War I Veteran

OFFICIAL publication of "the Historical Associate Members of the Institute of the Aeronautical Sciences," No. 1 (vol. 8) of the journal "Aeronautica" contains an unusually interesting article on the reconstruction of a veteran British military aircraft, a Sopwith Snipe. The author is Jack D. Canary, and below, with acknowledgements, we print the major part of this article. It is gratifying that a number of English firms, organizations and individuals have co-operated with the reconstructor in his enterprise.

The Snipe during its conversion.

ON September 22, 1918, the second production Snipe 7F-1, serial No. E-6938, was accepted from the Ruston Proctor Co., and assigned to armament tests at Farnborough.

Today, July 10, 1956, Snipe serial number E-6938 is about to leave the hangar again. The place is not Farnborough, but Southern California in the United States of America. How did this veteran survive all these years and what brought it halfway across the world into the hands of Jack Canary? Well, that's a long story in itself and will be told at the proper time and place. At any event the fact remains that it did survive, it is still with us and will soon be completely rebuilt exactly as it was in that far off September day in 1918.

Space does not allow a complete description of the work involved in giving this old veteran new feathers, but some interesting highlights of this project are described for the benefit of those many enthusiasts who have often dreamed of tackling such a job.

First of all, and most important, the aircraft was found to have been heavily modified by its previous owners and little trace of its original configuration could be found in what was left of the aircraft. This was a mild understatement, too, as it turned out, for many valuable pieces of the airframe and engine were found to be missing as an inventory of the remains was made. Thus the first chore facing me in the process of rebuilding old E-6938 was that of determining the exact original details of the aircraft in those areas that had been modified and then start the search for the missing parts. In some cases, as one could well imagine, the search was fruitless and thus design and manufacture of new parts was required.

Starting in September of 1953, I completely disassembled the plane with the help of fellow members of the I.A.S. and during the year 1954 spent most of my time cleaning, repairing, or replacing those parts which I already had. At the same time a ream of correspondence was begun in this country and in England to pry out the needed data on rigging, cockpit details, instruments, armament installation, engine and propeller.

During 1955 information slowly began flowing in as the reassembly of the airframe proceeded. Certain items, like the propeller, were completely non-existent and thus several months were spent in studying the design of wooden airscrews; then, with fingers crossed, proceeding to design from scratch the needed propeller. Further months were spent in submittal of the drawings to the few firms still in the business and finally the thrill of contacting one who would do the job.

So it went with each component of this little monster, as it sometimes seemed to be. Neither magneto for the engine was available in 1953. Now two magnetos of the exact type are in process of rebuilding in England by the firm which bought out the original producers in 1919. This hunt was the result of help from such old-timers as Frank Courtney, who was instrumental in locating the designer of the P.L.M. magneto. The Bentley B.R.2 rotary engine was found to be in overhaulable condition, but lacked many parts and needed much rebushing and repair work. At present the engine is completely reassembled and installed in the fuselage. It is runable and is entirely airworthy.

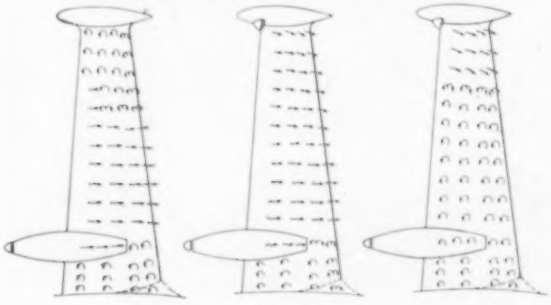
Much data was desired on the instrument panel and instruments. Contact with S. Smith and Sons in London produced original drawings of the instruments used in the production aircraft. From these drawings accurate reproductions have been made which are completely operable and authentic. And so it goes as the little beauty nears completion. The Flightex Co. generously donated fabric for the entire aircraft. The Northrop Aeronautical Institute completely rebuilt and recovered all four wing panels. Other local I.A.S. members such as John Sloan, Dustin Carter and Warren Bodie have contributed of their time to help this wonderful little creation of a bygone era grow its new set of feathers.

The Dunlop Rubber Co. in England have re-rimmed the graceful wire wheels and installed smooth contour tyres of the exact size of the originals. Countless other individuals and groups have contributed to this programme in a heartwarming manner.

DISCOURAGING THE STALL

THE production version of the Pasotti Airone F.6 light twin-engined executive aircraft (described in *Flight* for July 13, 1956) carries its fuel in permanently attached tip tanks. It was found, however, that these tanks caused turbulence over the outer wing at high angles of attack; and a device patented by Dr. Longo of Milan was adopted to cure this condition. The device consists of a small aerofoil attached to the inboard flank of the tip tank, above the wing leading edge, and has the effect of smoothing the airflow over the outer wing even at very pronounced angles of attack.

Wool-tuft behaviour on the Airone model wing (l. to r.) at 15 deg without aerofoil device and at 16 and 22 deg with it.



A wind tunnel model of the Airone with a span of 1,430 mm, a length of 1,046 mm and a wing area of 30.2 sq decimetres, was made of nut wood, painted in white nitrocellulose and polished. At a wind speed of 131ft/sec, the behaviour of 61 wool tufts applied over the wing in four spanwise rows was observed, both with and without Dr. Longo's aerofoil in place.

Without the aerofoil attached, slight turbulence arose between the fuselage and engine nacelles at incidences between 10 and 12 deg, and spread over the nacelle itself at 14 deg. At this point turbulence also appeared in the three chordwise rows of tufts next to the tip tanks and, at 15 deg, this turbulence was spreading inboard. The result of this would be a stall at the wing tip and root at a not excessive angle of attack, with loss of effective aileron control early in the stall.

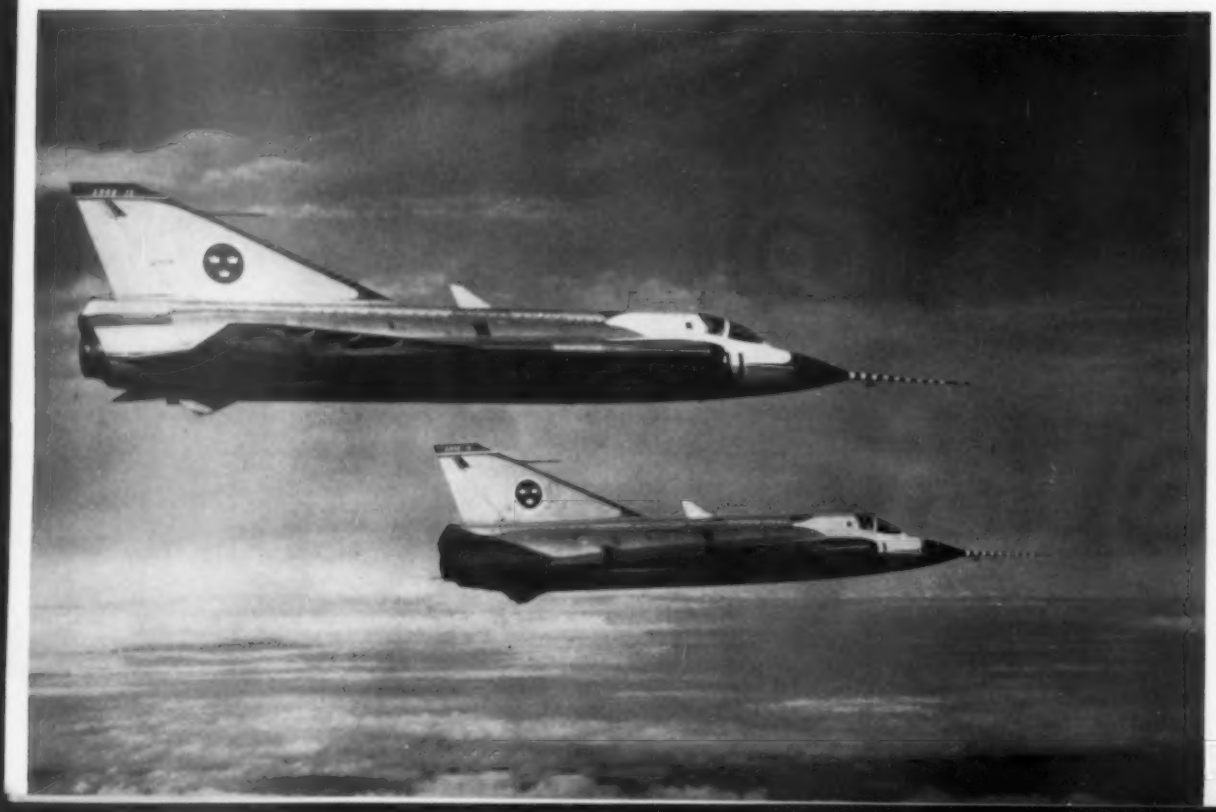
With the aerofoil device attached to the inner flank of the tip tank, results were vastly improved. At incidences beyond ten degrees, the tufts at the tip were deflected slightly inboard but showed no tendency to vibrate. The wing root section behaved as before. At 16 deg incidence the root section was mainly stalled while the flow over the outer wing remained smooth and was only slightly deflected inwards. At incidences as high as 20 and 22 deg, when the whole inner wing was stalled, the three outboard chordwise rows of tufts remained substantially straight, with only slight vibrations. The aerofoil on the tip tank therefore was able to maintain a reasonable flow condition up to angles well into the stalling range.

SWEDISH DRAGONS

AT a time when most of the world's "major powers" are incessantly harassed by the problem of providing an up-to-date air force on a limited budget, Sweden continues to provide an object lesson in what can be achieved if national resources are properly utilized. Possibly no other nation has ever been quite so clever in knowing what it wanted in the way of military equipment and in designing and developing weapons which are as good as, or better than, those of other countries with immeasurably greater resources. Elsewhere in this issue we record the view, proclaimed last week by an authoritative speaker, that in quality of air force equipment Sweden is one of three countries that surpass our own.

Of all the recent products of the Swedish aircraft industry, that pictured here is the most remarkable. The Saab-35 Draken was designed to meet a specification, formulated by the Swedish Air Board in 1949, calling for a single-seat aircraft capable of intercepting transonic raiders under all weather conditions. It was also laid down that the new intercepter should be highly manœuvrable and heavily armed with the latest weapons, while retaining the ability to operate from modest airfields.

The "double delta" plan-form of the Draken is today well known, but it is only now possible to refer to certain other features



of the aircraft. Among these may be listed a lightweight, duplicated hydraulic system operating at no less than 3,000 lb/sq in; fully powered controls with artificial feel; integral tankage throughout; and an extremely sophisticated and highly developed structure. Power is provided by an advanced model Rolls-Royce Avon with afterburner, which is now in production—together with earlier-type Avons for the two-seater Lansen—at the Svenska Flygmotor factories.

In the accompanying photographs three of the development Drakens can be seen. It is of interest to note that they now have triple fences on the underside of each wing and a thickened inner trailing edge; also visible are the ports for what are presumably fixed guns in the leading edge of the wing, one immediately outboard of the kink and the other halfway along the acutely swept portion. (Depending on the armament carried, the gross weight varies between eight and nine tons.) A particularly curious feature is the vertical aerodynamic surface mounted dorsally ahead of the fin; while the reason for this may be purely aerodynamic, it is more probably some kind of aerial.

Development of the Draken has undoubtedly been the biggest task that the Swedish industry has yet faced. It has been carried to a most successful conclusion and the machine is now in full production for the Royal Swedish Air Force, in which service it will bear the designation J 35. Three of the prototypes were recently publicly demonstrated, and their excellent short-field behaviour and flashing performance—including level flight at speeds well in excess of Mach 1—showed that the machine is a remarkably good compromise.

TEST TEAMS

Some Psychological Factors in the Day-to-Day Work of a Flight-test Organization

By A. Cdre. A. H. WHEELER, C.B.E., M.A., F.R.Ae.S.

SENDING us this "slightly academic study" of basic psychology in flight-test work, A. Cdre. Wheeler says that although some people on the job know some of it and some know all of it, it is certain that not all of them know all of it. Here he endeavours to put the subject in some sort of perspective. He is certainly well qualified to do so, for after he commanded the Performance Testing Squadron at Boscombe Down in 1941 he held a succession of responsible technical posts culminating in the command of the A. and A.E.E. itself from 1952 to 1955.

LET it be understood at the start that nothing said in this article is intended to give the impression that there is any one perfect pattern for a flight-test organization. The form or pattern of such an establishment must depend on differing human temperaments. So far as mass production methods go it is possible to force human beings into some form of standard behaviour; but when it comes to requiring original thought and intelligent criticism on an undeveloped piece of machinery, then the human beings doing the work are almost bound to be diverse types. The same is, of course, true of all high executive appointments; again, that very lack of uniformity in human temperaments results in all successful establishments having a corresponding individuality which is devised to take account of the variations in human nature. If flight-test organizations are any different in this respect it is only in being even more difficult, since the nature of the work done is frequently more demanding and therefore more liable to unsettle tempers and get on nerves.

Components of the Organization.—The flight-test team in a firm is usually made up of four separate sections who are directly engaged on the work. There are the technical staff, who are an offshoot of the main design staff and are responsible to the chief designer or chief engineer in the firm; there are the maintenance personnel, who come within the organization of the works manager; there are the inspection staff, who usually come directly under the general manager; and, last but not least, there are the test pilots, whose reports go to the senior technical officer in the test team, but who usually come directly under the chief designer or chief engineer and, in some cases, have direct access to the general manager.

In setting out this chain of responsibility one is in some difficulty owing to the fact that the various appointments named often have different interpretations in different firms. The main principle, however, holds good in all organizations—the principle that the technical staff in the flight-test team interpret the requirements of the main design staff. The maintenance staff then prepare the aircraft according to those requirements. Experience has shown that it is advisable to have a completely separate inspection staff who supervise the overall safety of the aircraft and its equipment during the period of preparation for flight. Finally, the pilots operate the equipment in the air and assess it, with or without the aid of technical flight observers and various forms of instrumentation.

Among the whole team the chief test pilot has a unique position, since he alone will have been concerned with the development of the aeroplane from its earliest design stages. He will also be needed to follow it through till it is being operated satisfactorily by the customer. This means that he will have been closely in touch with the chief designer when the original specification was first considered and will ultimately be closely in touch with the technical sales staff when the aircraft is delivered to the operator.

Liaison Within the Team.—When the pilots' test reports come in it is the duty of the technical staff in the flight-test team to analyse them, discuss any doubtful points with the pilot concerned and decide what further tests are required. The senior technical officer in the team must keep the main design staff informed on the progress made. This individual, therefore, becomes one of the key men in the team, even though he may be a relatively junior member of the main organization. Clearly he must be in the confidence of the chief engineer (or designer) and have the confidence of the test pilots. He should have a practical working knowledge of maintenance work so that the test rigs he asks for are reasonably easy to fit up. Lastly, he must be on good terms with the head of the inspection staff to ensure that the inspectors are kept fully informed on all work being done, and he must be prepared to listen sympathetically to any doubts which that staff may express.

Although confidence and good relations are necessary throughout all organizations, nowhere is it more essential than between the design staff and the test pilots—which usually means between the senior technical officer in the test team and the chief test pilot in the firm. This is particularly true when the flight-test work is done at an airfield remote from the main works and therefore remote from the chief engineer and his staff. Although this remoteness is regrettable it is often inevitable, but it need not be a serious handicap if the chief engineer or designer makes a point of visiting the flight-test team regularly and talking to the personnel there—particularly the test pilots. If this is not done there is a tendency for the main design staff to become more and more academic in their outlook and less receptive to minor criticisms of the original design. They may even get into a state of mind when they feel that their responsibility ends when they have got the "thing" away from the main works. Unless the leader of the design staff keeps closely in touch a lack of understanding between Design and Test will result, with the pilots becoming more and more suspicious of the products they are asked to try out.

If this is allowed to go too far a situation could arise where the senior design staff look upon the test flight merely as a nasty hurdle to be got round or ignored (if it can't be got over) and the test pilots as a lot of over-paid, over-glamourized, under-educated individuals who ought to be told where they get off. As a return compliment, the test pilots might come to refer to the senior design staff as a small and fuddled huddle of over-promoted junior draughtsmen with deliberately homicidal tendencies. Both sides probably would agree only on one thing, that on no account must they take the other into their confidence!

Luckily this nightmare type of situation is rare, if not non-existent; but the thought of it might well be kept in mind, so that a proper importance may be attributed to the selection of members of the flight-test team. By the nature of their work many of them will be young and therefore relatively inexperienced, yet desperately keen on their job. Their comparative inexperience in technical matters is not of great importance, since they can get guidance from their seniors or from a book; but their inexperience in the psychological handling of people, coupled with their intense keenness to get on with the job, will often lead to minor forms of bickering. These, fortunately, will not become serious so long as the team has plenty of interesting work to do and confidence in their seniors whilst they are doing it.

Ejection of Discordant Elements.—Only the management can provide that essential atmosphere of confidence throughout the whole organization, confidence that the work being done is really worth while and that good work will be recognized and rewarded. There is always a faint fear in some people's minds that their own hard work won't be appreciated and that some other individual who talks a lot and does very little will "get away with it."

Nothing can be so destructive to proper team work as a lack of confidence or co-operation around the top layer of the organization. A breakdown may be due to someone developing that type of temperament usually associated with a prima donna; the chief test pilot can develop it, in which case it usually takes the form that his opinion on any aerodynamic characteristic is final and that a second opinion is quite unnecessary; or the chief designer may develop it, when it may take the form that his design is right and any criticism of it is a personal insult. Both, of course, may develop temperaments simultaneously, when the situation becomes serious indeed.

But usually the discordant element is more difficult to detect. At least one concrete case can be quoted where an individual was taken on in a large organization to do a job within (but not directly under) the flight-test or design sections. Being an ambitious individual, he set about criticizing the efficiency of everyone running sections alongside his own. He kept and displayed numerous charts to show how efficient his own section had become since he took it over and how he was being hampered by various inefficiencies in adjacent sections. Before three months were up he had induced an atmosphere of suspicion and mutual distrust in the whole organization, ranging far beyond his own section. Soon other sections started cooking up other rival charts to prove that they weren't as bad as implied. The actual loss in efficiency throughout the whole organization, due to this one man's ambition, could not be calculated; but the real responsibility for the loss rested with a senior individual who failed to assess the culprit's character and to keep him in order.

This was, of course, an extreme case but it illustrates how important it is to control or eject discordant elements even if, as in some cases, they are extremely able people.

The term "discordant element" must not be taken to include

HAVING A FLUTTER

This is an electronic analogue computer, designed and built by ENGLISH ELECTRIC for work at their Aircraft Division's Research establishment at Warton on problems of aircraft flutter and stability. A mathematician with a desk calculator would find it fairly easy to solve problems of flutter in two degrees of freedom, very difficult to solve problems in three degrees of freedom, and impossible to go further. This machine solves, in a few minutes, problems of flutter in six degrees of freedom. This does not mean that the mathematician becomes redundant. To produce the figures for a family of problems for the computer to work on may easily take him a fortnight. The computer then does in an hour or so what would take the mathematician 6 months to do—supposing he could do it at all.

On problems of stability the computer can do a theoretical analysis, which it can then translate into practical terms with the aid of a mock-up cockpit, complete with flying controls, simulated instruments and a cathode-ray artificial horizon. In this way a pilot can study the effects of different control and stability characteristics without ever leaving the ground and can get a fair approximation of the feel of a projected aeroplane before it has been built.

Thus, with ever more elaborate equipment, are ENGLISH ELECTRIC designing today the aeroplanes of tomorrow. For when aircraft are required to fly at stratospheric heights and supersonic speeds, hopes and hunches must give way to science and certainty.

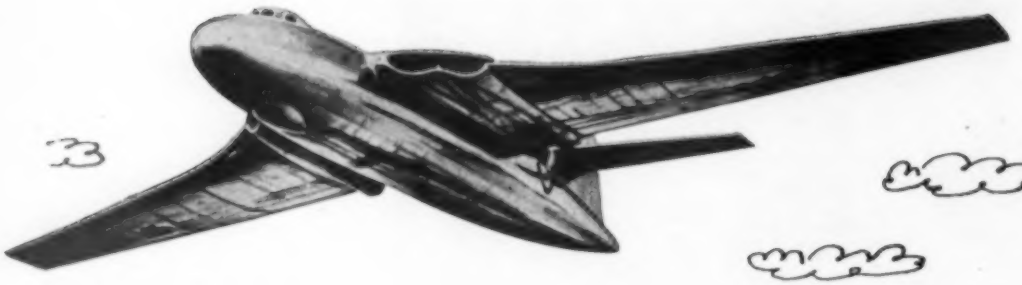
Design starts from an attitude of mind

Partners in Progress with Marconi and Napier in THE ENGLISH ELECTRIC GROUP

'ENGLISH ELECTRIC' aircraft

QUEENS HOUSE • KINGSWAY • LONDON • WC2

D



In the air . . .

on the ground . .

F-R REFUELLING COMPONENTS—all along the line

FLIGHT REFUELLING LIMITED

Tarrant Rushton Airfield, Blandford, Dorset.
Telephone : Blandford 501. Telegrams : Refuelling, Blandford.

TA/173

TEST TEAMS . . .

forceful personalities. Anyone in a team must be allowed to express his opinions, and, indeed, to do so emphatically. It is frequently only after a most heated argument, particularly among young people, that the right answer will come out. However acrimonious the argument, if the people concerned are all really interested in getting the right answer there will be no lasting bitterness—only, perhaps, a better appreciation that none of us (not even the youngest!) is infallible.

On occasions there may be one concerned in the argument who, against all apparent logic, still persists in trying to push his own viewpoint. In such cases it is usually unwise to damn him outright as an obstinate young so-and-so. There is still so much unknown in flight test work and our methods of qualitative assessment are still so unscientific that there be some good reason for his obstinacy, even though he himself cannot properly express it. His attitude may, of course, be induced by self-complacency or by stupidity: if it is the former you blame him, if the latter you blame the man who took him on and kept him in the team.

The whole problem of discordant elements has been given a lot of prominence here, not because those elements are peculiar to flight-test work, but because the very nature of this work tends to aggravate their harmful tendencies. These elements are usually most active but most imperceptible when work is light and the job is dull. The extent of their disruptive efforts, however, becomes very evident when the discordancy induced amplifies a crisis.

Disruptive Crises.—When there is a crisis in flight-test work the design staff are likely to be overworked and tired; the test pilots may well be slightly "on edge"—perhaps more than slightly, according to their temperament. Then it only needs a small seed of suspicion and a bit of no-confidence for a minor crisis to develop into a major row which will require a considerable effort to quell.

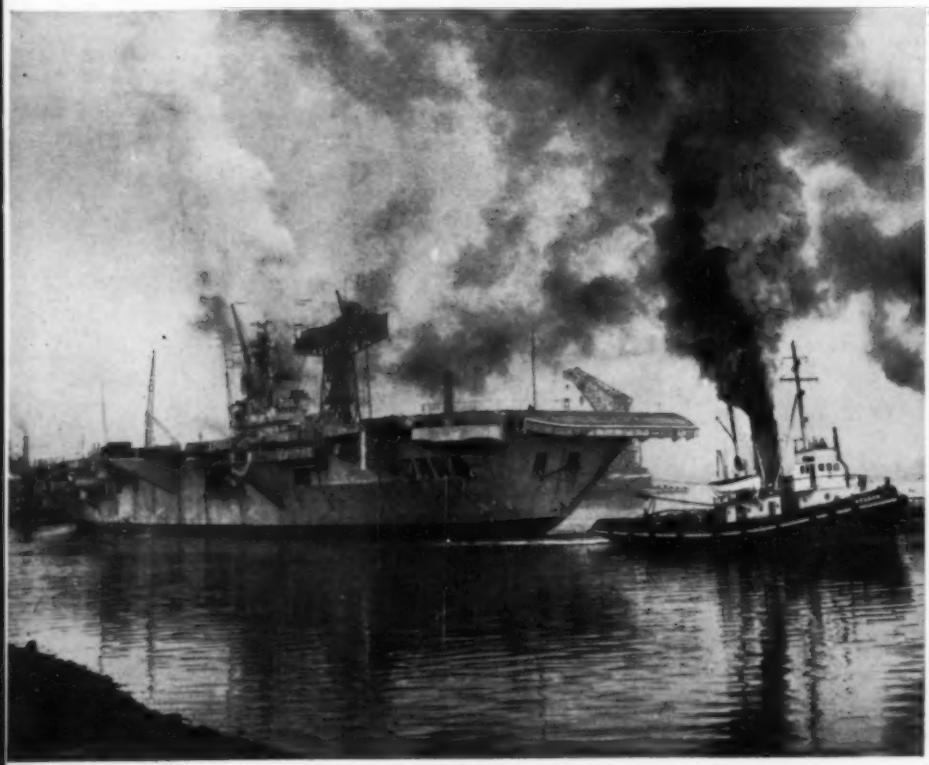
In order to appreciate the need for a really well-ordered, temperamentally well-graded, confident team one must visualize the kind of disaster they may have to face. It may occur in the very last stages of development of an aircraft, when tests seem to reveal that only some major structural modification can eliminate a dangerous aerodynamic vice. Then the test pilots are under very severe questioning (to put it mildly) to make certain that the vice they report is really serious. The designer is under pressure, either to disprove the vice or produce some magic minor modification to eliminate it. The management are under stress, wondering whether it will all turn out to be a "hare" or whether, in fact, the production line is at that very moment expensively churning out unwanted scrap. If the disaster turns out to be a real one, then it is deep in human nature to look for a scapegoat. If a witch-hunt is allowed to start it is a paradise for ambitious discordant elements. At such a time the management's responsibility will be vastly lightened if the team was sound before the storm broke; but—with a million pounds down the drain—they will still have to find a few encouraging words to say to those who saw "the things they gave (five years of) their life to, broken." By doing so they will help to keep the team together. When the aircraft flies again, and flies better, a good team will have become a better one for its months of tribulation.

Interdependability of the Experimental Team.—It is hoped that the paragraphs above will have given an impression of the extent to which every section in the organization for flight-test depends on the rest. The pilots depend entirely on the skill of the design team and the reliable work of the technical staff, the maintenance crews and the inspection. The design staff depend almost all the time on the opinions of qualitative assessment of the pilots. If the pilots sometimes talk a language rather different from that of the design staff it may be puzzling; but interpretation is possible. Pilots may exaggerate a fault or, worse still, may fail to detect one, but on the whole the design staff get the answers they deserve to the questions they put.

The management may get maddened by the delays and uncertainties of the flight-test team but it will still pay them to have a strong one. The policy of keeping a test team small and junior so that they won't have enough influence to hold up production by minor criticisms is now out-dated. Modern pieces of machinery are seldom designed outright; they are mostly evolved by trial and error—the trials are done by the flight-test team, the errors are made by the design staff!

W. J. JAKIMIUK'S NEW POST

THE appointment is announced of W. J. Jakimiuk to head the sales division of Sud-Est Aviation. Mr. Jakimiuk is well known for his notable "P.Z.L." designs while, in pre-war years, he was chief engineer of the National Aircraft Establishment, Warsaw. From 1939 to 1940 he was with S.N.C.A.S.E. and for nine years thereafter was chief engineer of de Havilland Canada, where he contributed to the war production of the Anson and Mosquito and designed the Chipmunk. On his return to England he directed the development of the Vampire and Venom night fighters. In 1951 he returned to S.N.C.A.S.E. as director of special research, being responsible for development of the Baroudeur trolley-launched attack aircraft.



DOWN TO THE SEA: "BONAVENTURE" READY FOR TRIALS

THERE is something strikingly Turneresque about this photograph of the 18,000-ton Canadian aircraft carrier H.M.C.S. "Bonaventure" as she was towed out recently from her Belfast berth for preliminary sea trials. Built by Harland and Wolff, she was originally named H.M.S. "Powerful" and was launched in February 1945, only to lie uncompleted until July 1952, when she was purchased by the Canadian Government to replace H.M.C.S. "Magnificent," loaned to Canada by the Royal Navy. Subsequently she was given her present name.

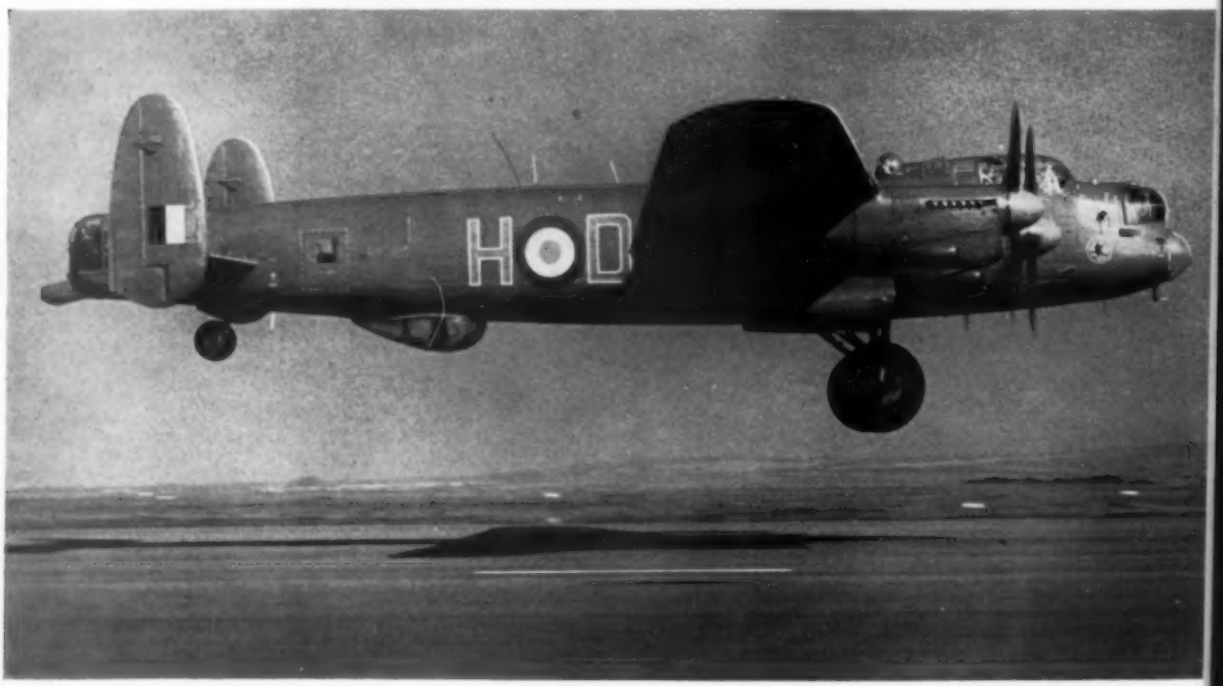
The Lancaster's final Service flight, its delivery to the M.U. at Wroughton, is recorded in these views of its take-off from St. Mawgan (below) and its final peel-off from the photographic Shackleton (left). The crew (above) was led by W/C. E. J. Brooks, third from left, C.O. of the School of Maritime Reconnaissance.

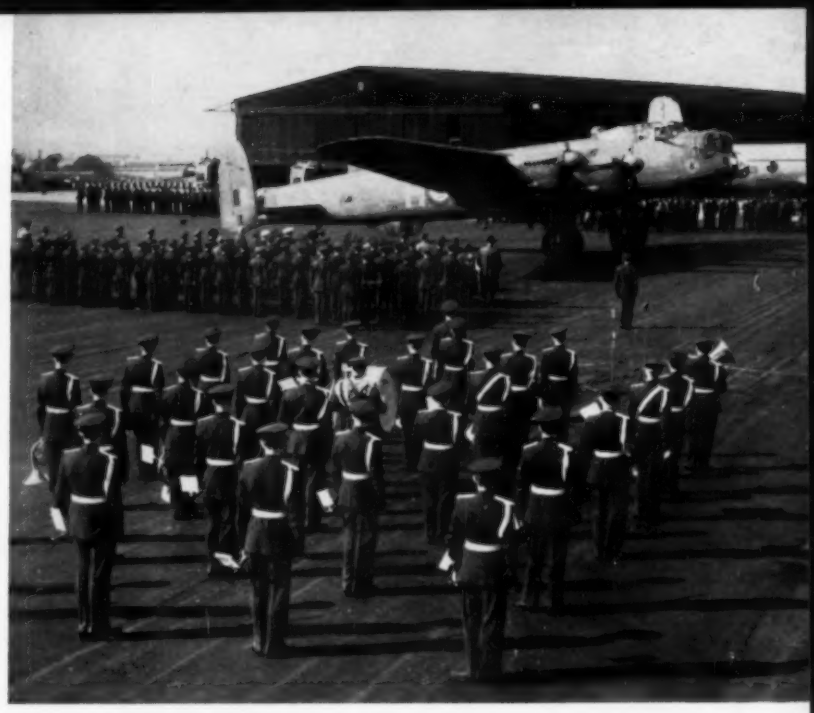
GOOD-BYE TO THE LANC

"FLIGHT" photographs

A FAREWELL ceremony marked the departure from R.A.F. St. Mawgan, Cornwall, on October 15, of the last Lancaster in R.A.F. service. Air Marshal Sir Bryan Reynolds, A.O.C.-in-C. Coastal Command, recalled in a speech the great record of the Lancaster in Bomber and Coastal Command service since 1941. A.V-M. G. A. Walker, A.O.C. No. 1 Group, Bomber Command, said "We feel moved in saying farewell to this very faithful friend."

Captain of the last Lancaster, D for Delta, on its final Service flight was W/C. E. J. Brooks, C.O. of the School of Maritime Reconnaissance. As he started the engines a guard of honour was drawn up beside the aircraft and an R.A.F. band played "Auld





The guard of honour is drawn up and the band plays as the last Lancaster taxies out for its final flight.

Lang Syne" and the "Dam Busters" March. Other members of the crew were S/L. H. W. Taylor (air electronics officer), F/O. D. G. Spencer (navigator), Sgt. J. A. Hennessy (engineer) and Sgt. D. Lerwill (radar operator). W/C. Brooks, incidentally, sunk the first U-boat credited to the R.A.F. in World War 2. S/L. Taylor flew on 37 Lancaster operations.

The accompanying *Flight* photographs record the ceremony and the last flight to the M.U. at Wroughton, where the machine is being broken up.

LANCS AT WAR

BY THE EDITOR

OPERATIONAL nights on Lancs are far enough in the past for the miseries to have been forgotten and only the splendid squadron spirit and personal feeling of worthwhileness to be remembered. An excess of nostalgia would be more than a little sickening, particularly to a non-flying audience; yet the Lanc will not have touched down for the last time in the R.A.F. without reminiscent sighs from many thousands of aircrew men. A recollection or two, therefore, may not be out of place to accompany these photographs.

I do not remember ever having met a pilot who did not like the Lanc. Most men in Bomber Command had a profound confidence in the ability of the aircraft and its four Merlins to get them home, come what might. The throbbing roar of the four engines, as they strained at the start of a take-off run, their exhaust flames lilac plumes in the twilight, really was music in the ears of an operational crew. No harp or flute ever dispelled tension as they did, for it was the long waiting before take-off that was hell, not the flying to and from. Even today, the take-off in a North Star or Argonaut can have the same evocative effect on an ex-Lanc man, travelling in it, as does a bugle-call on an old charger.

First introductions to a Lancaster in Bomber Command were usually at an L.F.S. Perhaps considerably discouraged by his inability to land a Stirling as it ought to be done, a new-from-conversion-unit pilot was taken off for a circuit or two in a dual Lancaster and then launched with his crew. Except for the fairly limited space, he liked almost everything around him better than on any previous bomber of his experience. Here was a machine with response and spirit, which reacted to its controls like a big Tiger Moth. It enjoyed bags of bank, and it three-pointed instinctively. You could see out of it well; it would fly on any two engines; there was power to spare; the brakes worked well.

First impressions did not prove disappointing, because the L.F.S. Lancs were no demonstrators (although the "screened" instructors were quite persuasive salesmen). No, these were battered old machines, some honorably retired from squadrons, and the dual controls made them heavier to handle. Almost without exception the operational aircraft were later types with newer, better equipment, and engines from which more power was allowed to be taken.

Lancasters, like their crews and the stations they inhabited, developed operational personalities. They hung about listlessly on their dispersals when there was nothing on. They were glowering and round-shouldered when there had been a flap that had to be scrubbed, leaving them fuelled up, bombed up and fed up.

You soon learned to know at a glance whether a Lanc had a load on, and whether it was going anywhere. In the air it spread its wings a little wider and tilted up the tips—and it kept its head well up and breathed hard. On the ground, its legs were much shorter and its tyres like doughnuts—and the engines roared more and the brakes squealed louder.

The only sign that a Lanc enjoyed a day off was the way it would leap off the runway to take a W.A.A.F. signals officer to the next airfield. And it could be a little naughty when coming home late with nothing on board but a light-hearted crew. Let it touch its wheels down too early and it could buck like an old steer at Calgary.

In their tenser moments, Lancs were kind to their crews. They helped to keep calm in really rough weather; they never bit the hand that guided them; they could call on remarkable reserves of power and strength. There was the 44 Squadron machine that was blown on to its back by a near miss and eventually pulled out of the dive almost at ground level. Dozens of under-wing rivets had torn out; and the dihedral, visibly uneven in the early light next morning, would have suited an elastic-driven model.

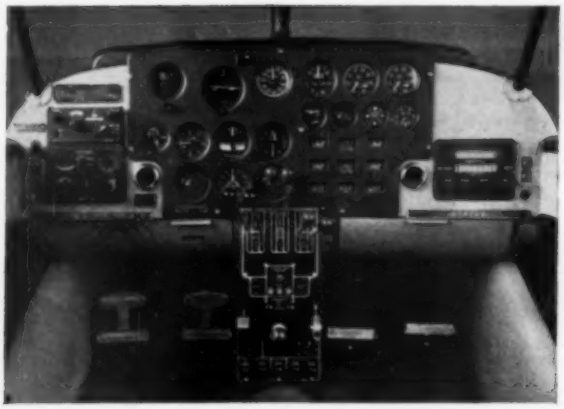
There was another fully loaded machine that was spun over Stuttgart at 20,500ft and recovered in time to make another run, and drop its bombs at 18,000ft. Remember the ten-hour (and even longer) flights with a big bomb load to places as distant as Königsburg up in the Baltic. Seeing "activity" lower down, one machine came home happily at 26,000ft—a good altitude for a wartime bomber but not so good for the rear gunner in his cold turret.

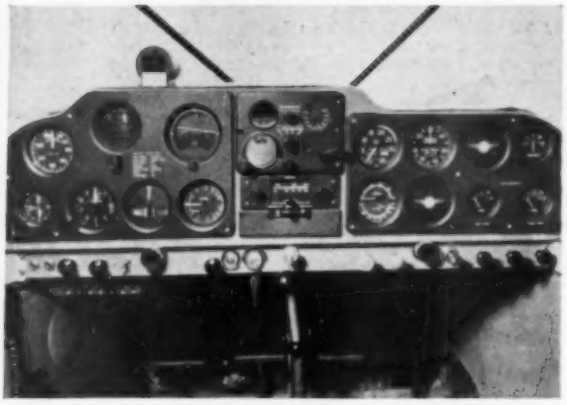
About top bombing height for a Lanc with full load and in the hands of an experienced crew was 21,000ft. A wag of a turret or a clumsy pull on the wheel could spill off 500ft at that height. And how the machine popped up, the releases almost twanging as a 4,000-lb cookie or a stick of 1,000 pounders fell away.

Bomb doors were always left closed after an operational trip until the armourers had double-checked for hang-ups. During the return over the North Sea, the bomb-aimer used to peep into the bomb bay through a tiny panel, but he could not always be sure that all the bombs were away. Quite a number of thousand-pounders came home resting on the doors, and more than one fell out on to the tarmac with a dull thud—followed by a few seconds of startled silence while onlookers decided whether to ignore, laugh or run.

Undoubtedly the most remarkable performance of all was the lifting of first the 12,000-lb and then the 22,000-lb bombs. The aircraft were operational from Woodhall Spa and took off at all-up weights of well over twice their empty weight. Nose and mid-upper turrets had been removed and Rolls-Royce had found some more boost, but they were still operational Lancs with crew, extra equipment for the bomb, and tail armament.

A typical wartime Bomber Command Lancaster, "PG How" of No. 619 Sqn., then of Dunholme Lodge, near Lincoln.





Exterior and interior views of the Piper Apache (upper photographs) and Tri-Pacer, 1957 models. Over 700 Apaches have been sold; cruising speed of the type is 170 m.p.h. The Tri-Pacer cruises at 132 m.p.h., its linked controls permitting co-ordinated turns with either wheel or rudder pedals. Radio equipment on both aircraft is comprehensive.

Piper Calls 1957 Tune

NEXT year's models of the Piper Aircraft Corporation's line of business and utility aircraft, "unveiled" at a distributors' meeting on October 24, include the re-styled versions of the Apache and Tri-Pacer here illustrated, in addition to the new Comanche four-seater. In the "completely new exterior paint design" of both Apache and Tri-Pacer is included the choice of Cadillac Red, Key West Blue or Pasadena Rose (which, if not a song title, certainly deserves to be) as main colour, with Daytona White cabin-top and black nose and nacelles.

The all-metal Apache retains two 150 h.p. Lycoming 0-320 engines as its power units, driving Hartzell full-feathering constant-speed propellers. Fuel capacity of the standard and "custom" versions is 72 gal, while the "super custom" model carries 108 gal. Dual generators and dual vacuum pumps are also installed in this latter version. Radio and navigation equipment fitted in the "custom" and "super custom" Apaches includes Lear ADF, Narco Omnigator (which combines VHF transmitter, receiver, 75 Mc/s marker beacon and ILS localizer) and Narco Simplexer 27-channel VHF transmitter/receiver.

New detail features of all models of the 1957 Apache include higher-capacity carburettor heaters and standard installation of carburettor air temperature gauges; numbered scales on the throttle quadrant; and additional cabin soundproofing.

In the 1957 Tri-Pacer, powered by one 150 h.p. Lycoming engine, a number of improvements in engineering and in styling are claimed. The most noticeable exterior change is the installation of a non-skid "running board" on the starboard undercarriage leg to facilitate entrance to and exit from the cabin.

The "super custom" model of the Tri-Pacer, which has accounted for some two-thirds of Tri-Pacer sales in recent years, is equipped with Narco Superhomer (with multi-channel VHF transmitter, VHF receiver and VOR navigation system) and Narco MF range and standard broadcast receiver. A fixed homing loop permits homing on range or standard broadcast stations.

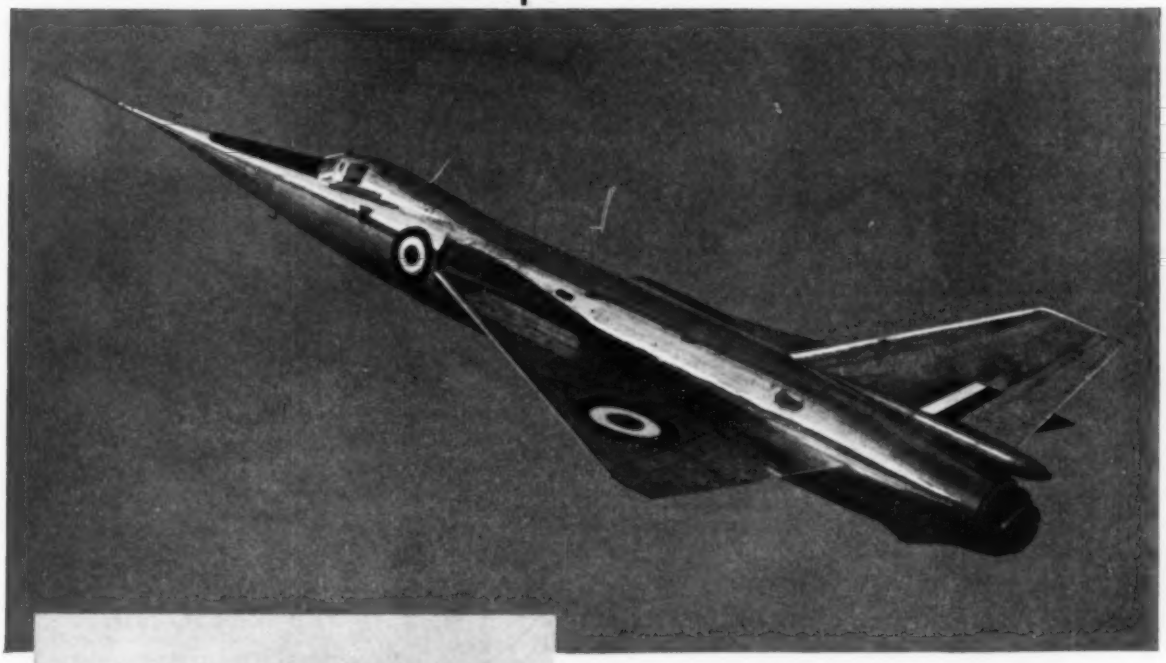
U.S. AIR RACING IN 1956

NEW national speed records in all categories for midget racing aircraft were set up in the U.S.A. during the 1956 air racing season, recently completed. The safety record of no fatalities since 1950 was continued, and there were more officially sanctioned contests than in any year since 1952.

Among the new records achieved were speeds of 208.81 m.p.h. (one lap) and 199.96 m.p.h. (main event) by Bill Falk in "Rivets" at the Niagara Falls meeting on July 7-8; and 203.67 m.p.h. (one heat) by Steve Wittman in "Bonzo" at the same meeting. Falk, who specializes in midget racing; Wittman, who has flown all types in every major U.S. air race since 1928; and Tom Cassutt, who began racing in 1954, have consistently gained high places in this season's programme. A typical course-distance for midget-aircraft races is twelve laps of a circuit of 2-2½ miles. The world 100 km record of 187.922 m.p.h. claimed by Richard Ohm in his Ohm Special midget on September 15 was reported in *Flight* of October 5.

The majority of the aircraft which were raced this year were those that had competed during previous seasons, with minor modifications. The Professional Race Pilots Association states, however, that "with the return of air racing now an accomplished fact, the frequent appearance of new airplanes, which keeps the sport constantly in a state of growth and development, will begin again."

Afterburners in NIMONIC alloys



Pressed ring in Nimonic 80 sheet for a Rolls-Royce afterburner.

Afterburners are a familiar feature of supersonic aircraft because of the great thrust increments they provide at high speeds. In the afterburners of British and British-licensed jet engines, extensive use is made of the Nimonic Series of High-Temperature Alloys, which are noted for their strength at elevated temperatures and their ability to resist oxidation, fatigue and thermal shock.

The continuous demand for improved performance has brought with it a steady increase of gas temperatures both in the engine and the reheat assembly. To meet the need for a material able to serve reliably in the more arduous conditions of the modern afterburner, Nimonic 80 has been introduced in sheet form for inner skins, fuel burners, flame holders and other parts in the vicinity of the combustion gas stream. In addition, Nimonic 75 and 80A are employed for support rings and certain other components.

OUR TECHNICAL SERVICE *is available to assist those with problems involving the choice of materials to resist corrosion or the effects of high temperatures.*

'Nimonic' is a Registered Trade Mark.

HENRY WIGGIN & COMPANY LIMITED *WIGGIN STREET · BIRMINGHAM 16*

TGA HT411

"...no problem of adhesion or sealing has ever beaten Bostik!"

When there seems to be no answer to a particular sealing or adhesion problem, let the BOSTIK technicians have a go! BOSTIK have the biggest and best equipped research laboratories in the business. Their unfailing success with problems involving new materials and techniques, new stresses and strains, new resistance to chemical and elemental forces shows that no adhesive or sealing problem defies solution for long. *But why not save a lot of the 'sticky' work by calling in BOSTIK at the start of a project!*

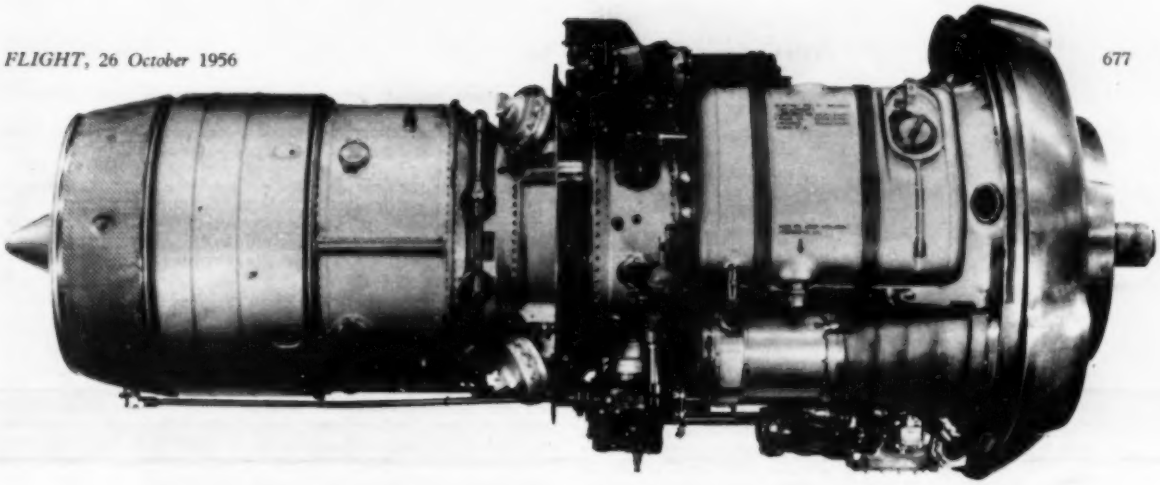
Makers of: Rubber/Resin Cements—inflammable and non-inflammable · Spray applied plastic coating compositions · Synthetic rubber/resin cements · Latex rubber/resin adhesives · Rasin cements · Self-curing natural and synthetic rubber cements · Natural and synthetic rubber solutions · Natural and synthetic rubber latex cements · Bituminous compounds for sound deadening, sealing and coating · Heat curing plastic sealers · Extruded plastic strip · Adhesives and sealing compounds resistant to high and low temperatures, oil, petrol and kerosene, acids and alkalis · Cements to a variety of Admiralty and Ministry of Supply specifications.

B. B. CHEMICAL COMPANY LIMITED, ULVERSCROFT ROAD, LEICESTER

CALL IN

Bostik REGD

AT THE DESIGN STAGE



ORION

First Details of Bristol's New Turboprop

DURING the early years of the present decade, the design engineers of what is now Bristol Aero-Engines, Ltd., frequently held informal discussions about the optimum future design of propeller turbine engines. It was then abundantly apparent that development of military turbojets such as the Olympus had resulted in the achievement of advanced thermodynamic cycles with pressure ratios and efficiencies appreciably higher than had been attained in any turboprop. By 1952 it was clear that it would be possible to design a relatively straightforward turboprop with a "straight-through" layout, two-spool compression, short combustion chambers and a highly efficient turbine in order to obtain very high power from a relatively small bulk, with a specific fuel consumption no greater than that of the most efficient piston engine.

A prerequisite to any engine design is a clear knowledge of the type of work which the eventual engine may have to perform. The obvious application for a new Bristol turboprop was the propulsion of later types of Britannia and its projected successors. At the outset discussions centred upon a project study, designated Bristol B.E.25, with a maximum sea-level rating similar to that of the Proteus, namely rather more than 4,000 e.s.h.p. Compared with the Proteus, the first B.E.25 project differed in having a straight-through, as distinct from reverse-flow, layout and compounded axial compressors. With a mass flow fixed at 40 lb/sec (the Proteus is about 43 lb/sec) and with a higher maximum temperature and pressure ratio and improved component efficiencies, it was immediately apparent that the engine could, for the same output, be much lighter than the Proteus, with a smaller installed diameter and 20 per cent better fuel consumption. This initial B.E.25 project was studied in three basic configurations: a single-shaft engine; a "single-spool" free-turbine engine; and a two-spool unit with the reduction gear driven off the low-pressure assembly.

Of these three arrangements only the third showed real promise. The first was rejected on various counts, including the inflexibility of the high-pressure compressor and the requirement for blow-off valves and variable whirl, the large starter power and the need for high idling r.p.m. to reduce acceleration time and increase propeller drag in the approach condition. The free power turbine was also rejected, since it was considered probable that easy starting and engine handling could readily be inherited from the split-compressor turbojet, and that it would be possible to avoid the full severity of coupling the propeller to the compressor. Thus, instead of receiving the full force of either of a pair of problems, the chosen configuration suffered a small problem from each, the rotating mass attached to the propeller being only quite moderate but the mechanical linking of the propeller and low-pressure assembly preventing the perfect matching of the two compressor spools in the manner which takes place automatically in an engine like the Olympus.

Having decided upon the geometrical layout for the B.E.25, the principal problem remaining was to find the optimum size for the new engine. Investigation revealed that the Britannia with four Proteus was nowhere near its Mach limit and could in fact utilize considerably greater cruise power. Furthermore, future long-range transports were likely to require substantially more power than could be provided by the Proteus. Fig. 1 shows the actual design point of the final B.E.25 project.

Dr. S. G. Hooker, the chief engineer of Bristol Aero-Engines, set his sights at a cruising power of 3,500 e.h.p. at 350 kt at 30,000ft, or exactly double the cruise power of the Proteus 755. Also written into this basic specification was a specific consumption not greater than 0.4 and the minimum of weight increase over that of the Proteus.

Extrapolation from the design point back to sea level results in an engine with a maximum output of over 8,000 e.h.p., and it was abundantly evident that this would not only pose a difficult development task, but would prove an inordinately weighty engine with excessive potential take-off power, either for the Britannia or for its intended successor. Fortunately, however, a very happy solution to this anomaly of excessive power presented itself. Partial-power curves of the projected high-pressure, two-spool engine showed that the specific consumption of such a unit would be relatively insensitive to throttling. In the Proteus, for example, restriction of power results in an increasingly rapid rise in specific consumption, but the B.E.25 project promised to exhibit this characteristic in a much more restrained form, primarily as a result of its more efficient thermodynamic cycle and better component efficiencies. The way was thus opened for the Bristol designers to plan an engine which, from the Britannia take-off viewpoint, would be markedly oversize, and then throttle it to a specified maximum output while still showing a substantial improvement over the consumption figures for the Proteus.

Owing to the propulsive characteristics of propellers, the turboprop provides a very great take-off thrust in relation to its cruising output, and this characteristic further accentuated the excess of take-off thrust available from the projected turboprop. This was another pointer to the solution of restricting the take-off power in order to effect appreciable savings in weight and bulk in the reduction gear and propeller. In fact, it was soon apparent that, as the shaft-power would never exceed 4,400 s.h.p., the new engine could quite readily be designed to incorporate the existing Proteus reduction gear and drive the standard de Havilland 16ft propeller as now in production for the Britannia. Material advantage was thus gained by designing a large engine, throttled for take-off, and, in the case of the Britannia, also under cruising conditions. Compared with the basic Proteus, the B.E.25 project was expected to weigh slightly more owing to the fact that the gas generator portion had to be increased in size in order to handle double the mass flow. At the same time the basic B.E.25 promised to offer ample reserve power for future Britannia development and also—for the first time in any gas turbine—to maintain its full sea-level ratings under all airfield conditions of altitude and temperature. The latter, which forms an interesting analogy with the power curve of a supercharged piston engine, has given rise to the appellation "the supercharged turboprop," frequently applied to the B.E.25 by Bristol spokesmen; other adjectives which have been employed are "constant-power" and "power-limited."

In any split-compressor engine one of the first design tasks is the determination of the optimum work-split between the two compressor spools. In the Olympus turbojet the low-pressure (front) spool has a lower pressure ratio than its counterpart, the

ORION . . .

work-split having been so chosen that each spool requires only a single turbine stage to drive it. The accompanying sketches show the self-matching characteristic of the Olympus compressors which is inherent in any properly designed two-spool turbojet. In the split-compressor turboprop, however, the relationship between the two shaft speeds is complicated by the dual variable factors of fuel flow and propeller pitch. The relevant sketches in Fig. 2 show the manner in which this change in r.p.m. ratio is dictated by propeller pitch as well as by power.

In the B.E.25 engine, on the other hand, the work-split has been reversed and it is the high-pressure spool which does the less work. If power is reduced from A to B (Fig. 2) by restriction of fuel flow, it can be seen that, owing to the acute slope of the operating line, the operation of the low-pressure spool only migrates very slightly towards the surge margin. At the same time partial power efficiency is maintained at a very high value and in regions well removed from the surge area. Completely separate controls for fuel flow and propeller r.p.m. are therefore admissible, although both are ganged together for approach and landing to restrict the possible rise in propeller drag. Power limiting is thus made much easier than with the alternative type of work split and the flexibility of the arrangement is apparent in the rather unusual behaviour of the B.E.25 from the viewpoint of variation of r.p.m., temperature and power with different flight regimes.

Detail design progressed during 1953 and a Ministry of Supply contract for prototype engines was placed the following year with Bristol sharing in the development costs. From the outset these prototype engines—four for bench running and two for flight development—have been built as complete powerplants with all accessories, systems and cowling in place. The first engine ran in December last year and another prototype started flight trials in a Britannia early last month. Further notes on the progress of the B.E.25, which has now been named Orion, are given after the detailed description of the engine as it is at present running.

DETAILED DESCRIPTION

It is a remarkable fact that although the Orion marks a complete break-away from the doubled-up, reverse-flow layout of the earlier Proteus, it is less than a foot longer than its predecessor and, in spite of its immense increase in power, is scarcely any heavier—in fact, the engine-change unit is actually lighter. As the accompanying drawing shows, the layout is typical of modern turboprops in that the reduction gear is built into the centre of a large circular intake casting which leads directly to the front of the low-pressure compressor.

As at present conceived, the Orion is made almost entirely of steel, the intake casting being the principal exception. Magnesium zirconium ZRE-1 is the alloy used for this component and it comes as a rough casting by Birmingham Aluminium Casting. The entire unit is made in a single piece with seven radial struts, the finished weight being 154 lb. Hot compressor-delivery air is fed through the compressor inlet guide vanes to an annulus around the rear of the intake casting, from which it leaves through two ports within the radial struts nearest to the horizontal on each side. It then emerges within the peripheral space around the casting, which is covered by a shroud formed from a thin sheet of stainless steel wrapped round the entire intake except for the lower portion, which is occupied by the oil sump. From this region the hot air flows forwards and then radially inwards along passages in six of the radial vanes and back along the vane leading edges to holes in the cowl, from which it discharges into the nacelle.

From the back of the intake casting rearwards, stainless steel is used throughout the primary structure. It is not proposed to describe the design of the rotating assembly and casings in detail except where the Orion introduces new techniques; the general arrangement of the engine is clearly shown in the accompanying illustrations and, in any case, follows closely upon practices established in earlier Bristol engines.*

The fixed-incidence inlet guide vanes upstream of the compressor are hollow steel units wrapped and welded from sheet and fabricated into rings by spot-welded end plates. Both the compressor spools are built up from discs stacked on their respective splined shafts and pre-loaded by large ring nuts (at the rear of the low-pressure spool and at the front of the h.p. spool). Earlier Bristol gas turbines employed multiple tie rods arranged around the peripheries of the discs, and the new method has been found to effect a marked reduction in assembly time. The ring nut is tightened while the end disc of each spool is seated on an abutment on its shaft and the inbuilt end load, which is reacted, as a nip transmitted through the peripheries of adjacent discs, is multiplied several times by the centrifugal force acting on the conical end discs during normal running. Each disc is balanced separately and the complete assembly is then run on a Gisholt machine and the balance made perfect by plugs at the ends of the spools in the usual manner. Such an arrangement has been found to maintain balance exceedingly well during all the running so far completed.

Tip radius is constant throughout both compressor spools. All compressor blading is stainless, the blades being machined from steel forgings. There is still much difference of opinion among engine manufacturers regarding compressor-blade materials; Bristol are firmly convinced that the ruggedness of steel blades makes for more reliable performance in service and are prepared to show that such blades can withstand impact with ingested bodies of appreciable weight without deflecting sufficiently to foul the stators. There is, however, a strong possibility that future marks of Orion will employ titanium alloy compressor stator blading with an appreciable overall saving in weight.

Both the l.p. and h.p. pressure casings are assembled from lower and upper halves which are all centri-die-castings in stainless alloy. Each casting is cut through at the horizontal joint face which is finished by a welded-on strip of precision-cast bosses. All portions of the carcase of the engine are through-bolted together in conventional manner.

Compressor stator blades are located in dovetailed grooves in the casing and are locked in place by axial bars and radial locking pins inserted through the joint flanges between the upper and lower halves of each casing. An additional stress-bearing shell is provided around the h.p. compressor casing to transmit engine loads through the maximum possible diameter, and, incidentally, to reduce the outer-skin temperature. All loads from the large, four-stage turbine are carried through the combustion-chamber skins and carcase. The outer shell takes radial and gyroscopic loads from the single-stage, high-pressure turbine, these being taken out through a "spectacle plate" at the rear of the combustion section. Axial loads on the high-pressure turbine are accepted by the adjacent ball thrust bearing and then transmitted through the inner drum of the combustion section and thence into the carcase through the exit guide vanes at the rear of the h.p. compressor. Loads from the three stages comprising the low-pressure turbine are transmitted rearwards to the thrust bearing and out through the eleven exhaust diffuser vanes directly into the outer casing.

As noted above, the independent high-pressure assembly is driven by a single turbine stage. A notable design feature is that the complete h.p. rotating assembly has only two bearings, whereas in the earlier types of Olympus turbojet there were inter-shaft bearings. Thus, in effect, the Orion requires three fewer bearings, discounting those in the reduction gear; diagram on page 682 clarifies their disposition and character. The h.p. assembly poses few problems since the turbine and compressor are quite close together and are connected by the large tubular drive shaft. The

*The Bristol Proteus 705 was fully described in *Flight* of June 6, 1952, and the Bristol Olympus on December 9, 1955.

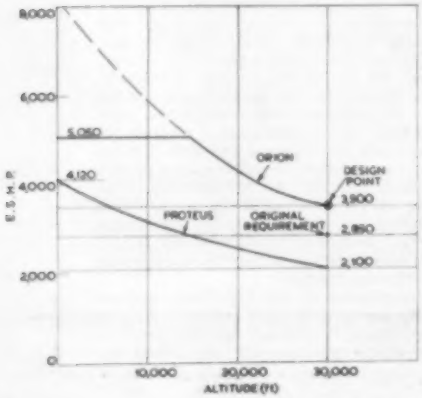
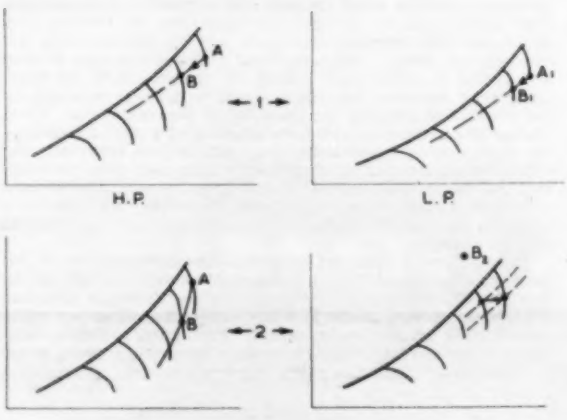


Fig. 1 (left). This diagram outlines the manner in which the size (i.e., output) of the Orion was fixed.

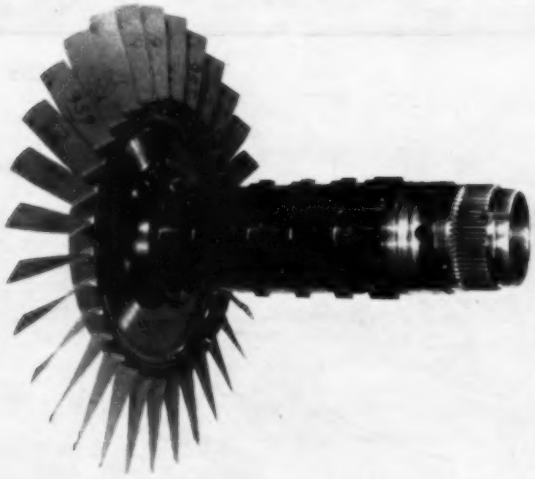
Fig. 2. Compressor curves (right) for two-spool engines: the upper pair (1) show the self-matching of a turbojet and the lower pair show the steep operating line of the Orion h.p. spool, which prevents the l-p. spool point from moving out to B_1 (surging).



front end of the latter is carried by a roller bearing mounted in the rear diaphragm of the intermediate casing and a ball thrust bearing, carried within the spectacle plate already referred to, supports the rear end of the shaft immediately ahead of the turbine disc.

On the other hand, the l.p. assembly is by no means a simple design problem in any two-spool engine. In some such powerplants the l.p. shaft is cut to form two separate whirling assemblies, but in the Orion a single "bottle" shaft joins the three-stage l.p. turbine to the rear of the front compressor spool, this shaft being machined from a tubular forging and having a very high whirling speed on account of its large diameter. The joint between the l.p. shaft and compressor has helically splined teeth so arranged that they generate a powerful axial load pulling the assembly together and helping to counteract the forward thrust of the l.p. spool and the rearward load on the turbine blades. As already noted, the residual axial thrusts are borne by the ball-bearings at each end of the assembly. All bearings are scavenged and pressurized with bleed air; seals are everywhere conventional labyrinths.

The three discs of the l.p. turbine are locked together in typical Bristol manner by rings of square dogs, the forward l.p. disc (number 2) being bolted to a flange splined to the drive shaft. The complete assembly is screwed up to abutments by a large ring nut on the rear end of the shaft. All four turbine discs are of Rex 448; Bristol have learned much useful heat-treatment and

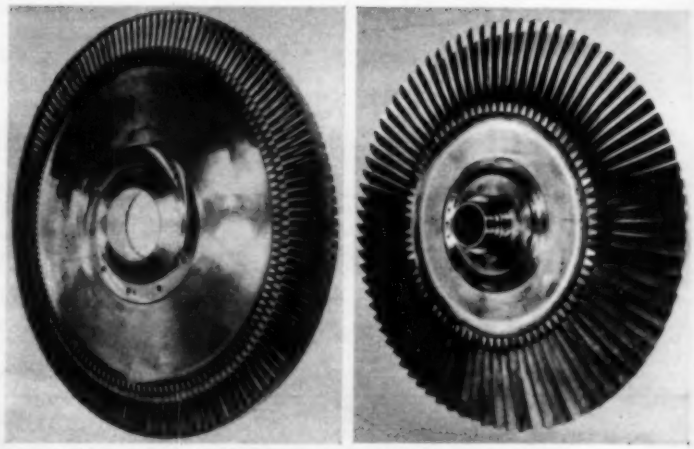


In the Orion low-pressure compressor spool the discs (only the first stage is shown) are located on individual rows of splines.

general fabrication technology from the development of this type of turbine structure. From front to back the turbine stator blades are manufactured from Nimonic 90, Nimonic 80, Nimonic 80 and Jessops G.18B.: the rotor blades are respectively of Nimonic 90, Nimonic 90, Nimonic 80A and Nimonic 80, all but the last stage being shrouded. These materials reflect the modest operating temperatures for which the Orion has been designed (the design point is 1,000 deg K or 1,300 deg F) and the provision of air-cooled blades or later materials would clearly allow a marked increase in temperature without penalty in life.

In the tubo-annular combustion space there are ten Nimonic 75 flame tubes of conventional design and low pressure drop. Each flame tube is identical to its neighbours and bears a resemblance to the Lucas splash-cooled cans of the Proteus; they are actually of Bristol design, based on Lucas work, and are agreeably short. Each is fed by a single Simpiex burner supplied from a fully shrouded fuel gallery. The A.R.B. have specified that casing temperatures in Zone 1 of a powerplant shall not exceed 175 deg C (200 deg C by special dispensation) and in a high-pressure engine like the Orion one has to feed in fuel behind casings at temperatures up to 380 deg C. Accordingly, the entire fuel-supply system is encased in stainless shrouding from which any leaks are ducted back ahead of the firewall. The gallery can be force ventilated and, although the sealing is of rubber, the assembly has always stripped excellently during development running.

Three independent oil systems are provided. The main (reduction gear) pumps are driven through a quill shaft running downwards from the reduction gear, and an auxiliary pump is driven from each compressor to feed the remaining bearings and to maintain lubrication should one rotating assembly continue to windmill in flight with the remainder of the engine at rest. An 11-gal tank, with circulating, reserve and feathering compartments, is strapped to anti-vibration mountings on the starboard side of the engine, and a 10in diameter light-alloy cooler is prominent



One of the most remarkable characteristics of the Orion is its low maximum turbine temperature. Above are illustrated the first-stage (high-pressure) and fourth (third l-p.) turbine wheels.

on each side of the l.p. casing, each cooler being in an air-supply trunk fed from a separate ram intake. As far as possible all oil piping is internal and one potential leak source has been eliminated by making the oil feed and scavenge pipes co-axial.

A single Lucas GBB swashplate fuel pump is mounted beneath the intermediate casing, with a drive from the h.p. compressor. A detailed sketch adjacent to the main cutaway drawing helps to make clear the operation of the fuel system, the control of turbine entry temperature being selected by a system of typical turbojet type, and an additional cockpit lever is provided to govern propeller r.p.m. It will be seen that, to a considerable extent, the control system resembles that employed in the Proteus. In present Orions an electric starter (24 or 110 V) is employed, mounted above the engine and driving the h.p. assembly *via* the intermediate-casing gear-train. An air-turbine starter is an alternative.

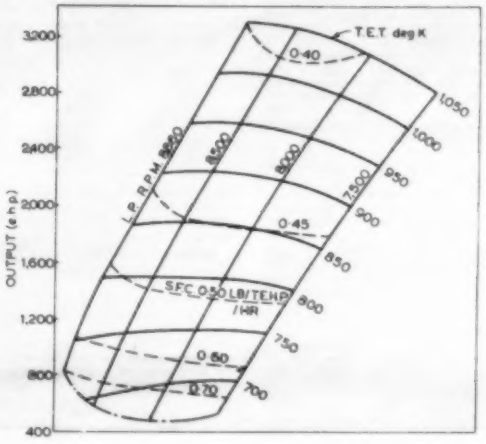
In-built equipment includes a hydraulic torquemeter and propeller brake and, in the Britannia, the h.p. compressor will drive a 47 kVA alternator. Provision is also made for bleeding-off air at l.p. delivery pressure from the manifold surrounding the h.p. compressor. When the Orion is throttled at low altitudes a considerable excess delivery of air is available which could be used for supercirculatory flap blowing.

As already noted, the complete engine is built up as a quick-change unit with integral accessory and cowling assemblies. The main fireproof bulkhead lies in the plane of the entry to the h.p. compressor and divides the powerplant into two principal zones. Ventilation of the forward zone is provided by air tapped from the ducting feeding the oil coolers or alternator which is then exhausted ahead of the bulkhead. The rear zone is ventilated solely by the alternator primary cooling air.

In Britannias the Orion is mounted on four air-cooled dynamic suspension units bolted to the outer casing of the h.p. compressor. Each anti-vibration mounting unit is of Bristol design, the supplier being Spencer Moulton of Bradford-on-Avon. Although the rubber in these mounts has a limit of 70 deg C, they have proved to give excellent service under all running conditions on the ground and in the air. The cowling forward of the bulkhead (i.e., immediately forward of the suspension units) is part of the engine

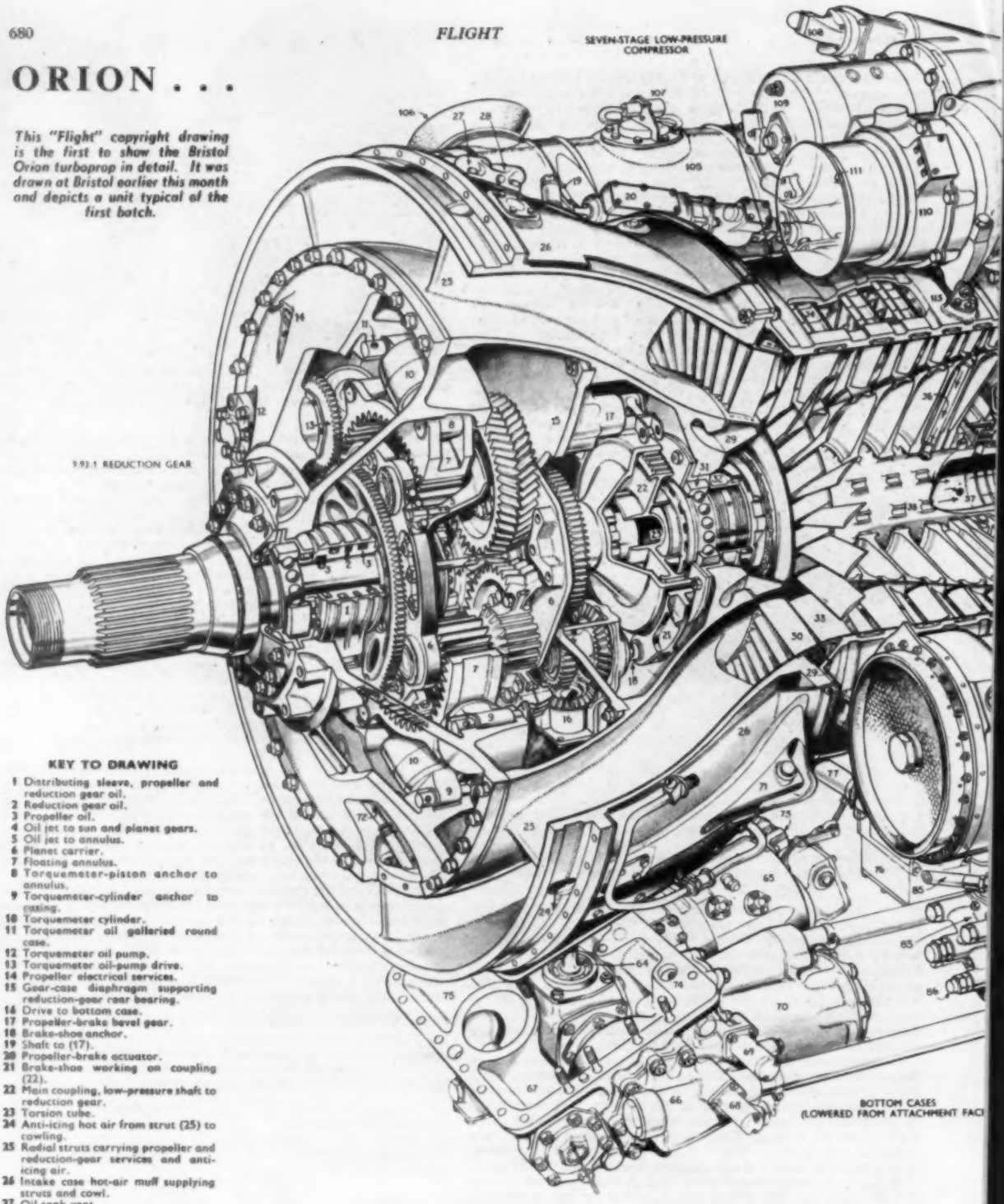
(Continued on page 682, after double-page drawing of Orion)

Estimated cruising performance for the initial type of Orion (8On.1) at 350 kt t.a.s. at the i.s.a. tropopause.



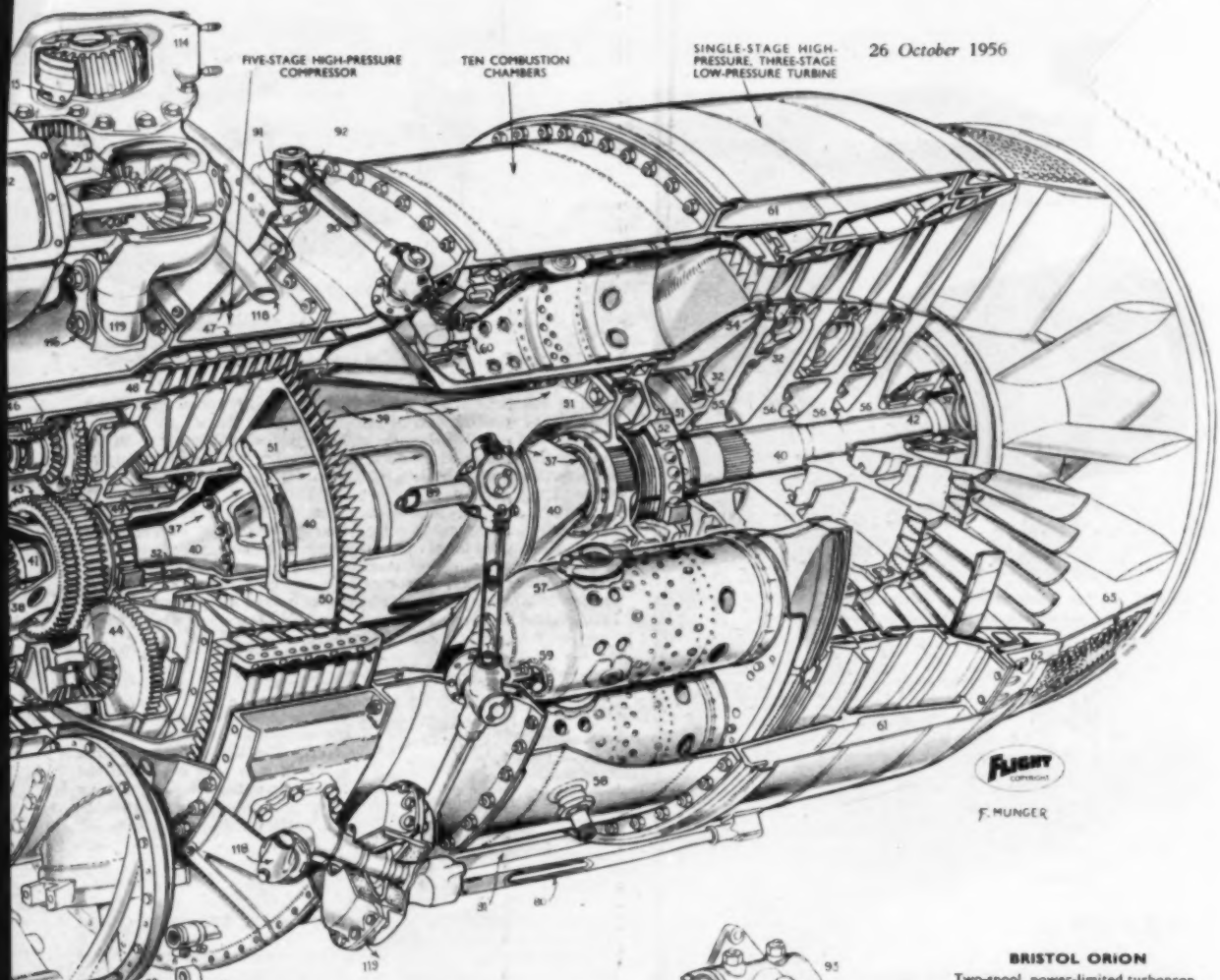
ORION . . .

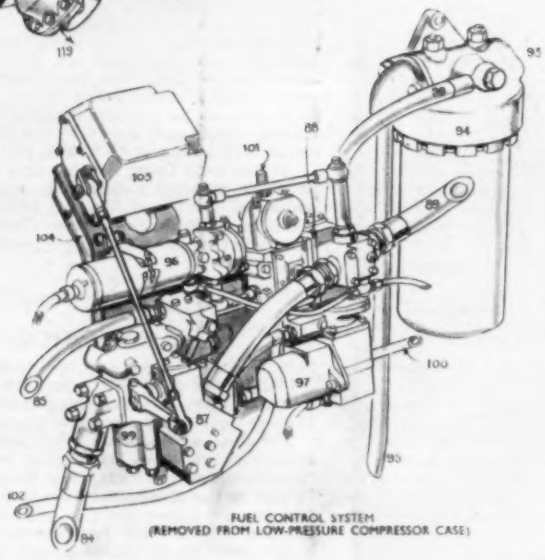
This "Flight" copyright drawing is the first to show the Bristol Orion turboprop in detail. It was drawn at Bristol earlier this month and depicts a unit typical of the first batch.



KEY TO DRAWING

1 Distributing sleeve, propeller and reduction gear oil.
2 Reduction gear oil.
3 Propeller oil.
4 Oil jet to sun and planet gears.
5 Oil jet to annulus.
6 Planet carrier.
7 Floating annulus.
8 Torquemeter-piston anchor to annulus.
9 Torquemeter-cylinder anchor to casing.
10 Torquemeter cylinder.
11 Torquemeter oil galleried round case.
12 Torquemeter oil pump.
13 Torquemeter oil-pump drive.
14 Propeller electrical services.
15 Gear-case diaphragm supporting reduction-gear rear bearing.
16 Drive to bottom case.
17 Propeller-brake bevel gear.
18 Brake-shoe anchor.
19 Shaft to (17).
20 Propeller-brake actuator.
21 Brake-shoe working on coupling (22).
22 Main coupling, low-pressure shaft to reduction gear.
23 Torsion tube.
24 Anti-icing hot air from strut (25) to cowling.
25 Radial struts carrying propeller and reduction-gear services and anti-icing air.
26 Intake case hot-air muff supplying struts and cowl.
27 Oil tank vent.
28 Vent through tank to intermediate casing.
29 Hot-air duct (supplied from high-pressure delivery on starboard side).
30 Hollow intake guide vanes heated from (29).
31 Low-pressure-shaft thrust bearing.
32 Labyrinth seals.
33 First stage low-pressure blading (all compressor blades steel).
34 Dove-tail stator roots.
35 Compressor-disc driving dogs.
36 Fifth stage air bleed to shaft centre.
37 Fifth stage air through shafting to bearings and seals.
38 Helical coupling, low-pressure compressor to turbine.
39 High-pressure delivery air to turbine seals.
40 Low-pressure turbine shaft.
41 Air-seal tube, passing fifth stage air through coupling.
42 Low-pressure turbine shaft rear bearing.
43 Low-pressure-shaft gear to starboard oil pump supplying l-p shaft bearings.
44 High-pressure shaft gear to port oil pump supplying h-p shaft bearings.
45 Gear train to top wheel-case.
46 Low-pressure delivery.
47 Low-pressure air bleed to aircraft services.
48 High-pressure entry guide-vanes.
49 High-pressure-shaft front bearings.
50 High-pressure fifth (final) stage blading.
51 High-pressure shaft.
52 High-pressure-shaft bearing.
53 Low-pressure-shaft intermediate bearing.
54 High-pressure turbine blades with extended roots.
55 High-pressure turbine disc.
56 Low-pressure turbine; last-stage blades unshrouded.
57 Combustion-chamber interconnectors.
58 Igniter-plug (two).
59 Combustion-chamber front attachment, permitting radial and axial expansion.
60 Simplex burner.
61 Turbine-casing shroud, collecting seal air.
62 Air from (61) returned to main gas stream.
63 Heat-insulating blanket.
64 Quill-shaft from gear (16) to propeller control unit, r.p.m. transmitter and oil pump.





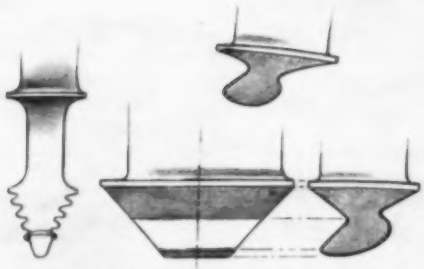
FUEL CONTROL SYSTEM
(REMOVED FROM LOW-PRESSURE COMPRESSOR CASE)

BRISTOL ORION

Two-spool, power-limited turboprop, with single high-pressure turbine stage driving five-stage high-pressure compressor and three-stage low-pressure turbine driving seven-stage low-pressure compressor and propeller. Overall diameter, 41.8in at intake flange; overall length, 112.3in from cone fitting to exhaust flange; equipped dry weight, 3,150 lb; mass flow, 82 lb/sec; pressure ratio, 10:1; take-off rating, i.s.a., 4,400 s.h.p. plus 1,950 lb thrust (5,150 e.h.p.) at 10,000 h-p. and 9,020 l-p. r.p.m. respectively, with turbine-inlet temperature of 1,035 deg K.

65 Propeller control unit.
66 Reduction-gear oil pump.
67 Reduction-gear scavenge filter.
68 Reduction-gear oil-pressure transmitter.
69 Reduction-gear oil-pressure warning light switch.
70 Propeller-control oil filter.
71 Propeller oil via (1).
72 Oil gallery to reduction-gear via propeller shaft.
73 Oil supply to propeller control unit from feathering pump.
74 Oil to propeller via (71).
75 Feathering oil filter.
76 Propeller-control actuator.
77 Oil-cooler outlet cross-feed.
78 Light-alloy oil cooler (air-cooled).
79 Oil to cooler inlet.
80 Low-pressure-shaft rear-bearing oil.
81 High-pressure-shaft rear-bearing oil (inner, supply; outer, return).
82 Quill-shaft from gears (44) driving oil and fuel pumps.
83 Main fuel pump (swash-plate type).
84 Main delivery from fuel pump to control system.
85 Fuel-pump servo pressure.
86 Fuel-pump priming air vent.
87 Throttle control valve.
88 Combined barometric-pressure control, shut-off cock and torque limiter.
89 Metered fuel delivery to burners.
90 Dual fuel gallery.
91 Inner fuel gallery.
92 Outer fuel gallery.
93 Low-pressure fuel supply to filter, then to pump.
94 Low-pressure fuel filter.
95 Low-pressure fuel delivery to pump.
96 Starting fuel pump.
97 Shut-off-cock actuator.
98 Return to pump suction.
99 Air-fuel-ratio control.
100 High-pressure compressor delivery air pressure to A.F.R.C. (99).
101 Ram-air pressure to B.P.C. (88).
102 Torquemeter pressure to torque-limiter.
103 Throttle actuator (Ultra).
104 Mounting.
105 Oil tank (capacity, engine oil 8½ gal, feathering oil 2½ gal).
106 Oil tank filler.
107 Tank contents transmitter.
108 High-pressure-shaft tachometer transmitter (l-p transmitter on front bottom case).
109 Starter motor (24 or 110 V).
110 Alternator (50 kVA).
111 Alternator cooling-air entry.
112 Alternator cooling-air discharge.
113 Alternator support point (two).
114 Centrifugal vent (oil tank and all wheel-cases).
115 Centrifugal-oil return holes.
116 Casing flexible mounts.
117 Dynamic engine mountings, ram-air cooled.
118 Ram-air to cool (117).
119 Cooling-air discharge.

The low-pressure turbine shaft and (separate) helical coupling.

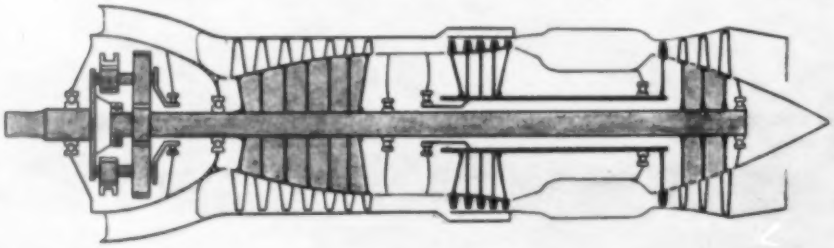


The Orion's high-pressure turbine has extended-root blades (left). The other sketches show side elevation and end view of typical compressor rotor-blade roots.

One of the ten flame tubes, of Bristol design based on Lucas work. An attachment is visible at the forward end.

Proteus installation, and the weight could be reduced appreciably both by the introduction of titanium and by the design of a new cowling and nacelle specially tailored to the requirements of the Orion. In passing, it is worth commenting on the fact that the jet-pipe diameter is no less than 26in, far larger than that for any other British turboprop.

Of the six prototype Orions so far built, four have been used for bench running and two are being used for flight development. About 900 hr had been run at the time of writing, mainly on three engines. All running has been to the proposed U.S./U.K. type-test schedule, which is appreciably more severe than the well-known 150-hr programme laid down by the M.o.S. and A.R.B. One engine has yet to come off the bed after more than 200 hr



This schematic diagram clarifies the mechanical arrangement of the engine. The high-pressure rotating assembly is in solid black and the low-pressure section and propeller drive is shaded. The location of bearings can also be seen.

ORION . . .

change unit and comprises the light-alloy nose ring (containing inlets for the cooling air, and a combined inlet on the upper centre-line for alternator cooling air and cold cabin-conditioning air), and a single-skin, light-alloy cowling with a large hinged panel on each side.

It should be noted that the present Orion powerplant for the Britannia is necessarily tailored to the bulkhead size dictated by the geometry of the Proteus, so that the later engine can be substituted within the period needed for major airframe overhaul, as B.O.A.C. intend to do. It is remarkable that the weight of the Orion powerplant is actually less than that of the complete running including 105 hr non-stop, and the full design ratings have been achieved throughout.

One of the flight-cleared Orions has been installed in the No. 1 position on G-ALBO, the first Britannia ever to be built. This aircraft began Orion flight trials early in September and has since made valuable contributions to the development of the engine. It is expected that a second Orion will go on to the No. 4 position on this aircraft early next year, and later in 1957 it is proposed to install four Orions in G-ANCA, the first Britannia 301.

All this early flying is being done with the present pattern of propeller, although a completely new design by D.H. Propellers (described in *Flight* of March 2, 1956) may be required for future —and more powerful—Orions. Certainly the engine offers very great potential for future development.

ESSO AVIATION MANAGER

IT is announced that Mr. J. G. Benson, formerly manager of the aviation department of the Esso Petroleum Co., Ltd., has been appointed manager of the company's national trade division and is succeeded by Mr. D. C. Ward-Campbell. Mr. Ward-Campbell, who joined Esso in 1935, served during the war with the R.A.F. as an instructor in Training Command. Rejoining Esso in 1945, he became aviation representative in the London area, later moving to a post at head office and subsequently to appointments in the company's Northern division. He returned to London in 1955 as assistant aviation manager.

UNCLOUDING THE ISSUE

OF interest to glider pilots, and others who might wish to influence the atmosphere in particular ways at particular times, is an article written by Dr. R. S. Scorer of Imperial College in the October issue of *Weather*, published by the Royal Meteorological Society. The article is a report of a meeting between Dr. Scorer, the Press and a man who claimed to dissolve clouds by a mental process. An experiment, made from the roof of the Meteorology Department of Imperial College and intended to test the claims of "Dr. A" to "unlock the internal molecular bonds" of clouds, was not conclusive; Dr. Scorer's account of the occasion is illuminating and amusing.

FOR YOUR DIARY

NOW is the time for buying new diaries, for personal use or as Christmas gifts, and there could scarcely be a more useful selection for the discriminating diarist than those published for 1957 by some of our associated journals.

The Autocar Motorist's Diary (leather, 6s; Rexine, 4s 3d) contains, *inter alia*, space for keeping records of running costs, and "trouble-shooting" charts. *The Motor Cycle* Diary includes the 16-page section of coloured maps of Great Britain found so popular last year (its prices are also 6s, leather; 4s 3d, Rexine). The *Yachting World* Diary (real morocco leather, 10s 0d; waterproof leather cloth, 6s 6d) includes such information as times of high water at Dover with tidal constants of the principal British and European ports, and a chart of the weather forecasting areas, with details of B.B.C. time signals and Meteorological Office shipping forecasts. Finally, there is the *Wireless World* Diary (leather, 6s; Rexine, 4s 3d) including in its 80-page reference-section base connections for 600 current valves; design data; frequency allocations; and addresses of radio organizations here and abroad.

All these diaries are published by T. J. and J. Smith, Ltd., of London, W.1, in conjunction with the journals concerned, and are obtainable by post from Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Prices quoted are inclusive of purchase tax, but postage is 3d extra in all cases. Overseas prices are in each case lower than the U.K. ones.

they all use *FAIREY* power controls

DAY FIGHTERS	Hawker Hunter Vickers Supermarine Swift Mk. 5 Aerfer Sagittario
CARRIER-BORNE FIGHTERS	Vickers Supermarine N.113 Hawker Sea Hawk
ALL-WEATHER FIGHTERS	Avro Canada CF-100
RESEARCH AIRCRAFT	Fairey Delta 2 *Holder of the World Speed Record at 1,132 m.p.h.* Avro 707C
HEAVY TRANSPORT AIRCRAFT	Blackburn & General Aircraft Beverley
TRAINER AIRCRAFT	Fiat G.82

Fairey Power Controls embody all the required characteristics for use both in high performance and transport aircraft. The power control illustrated is a fully duplicated unit and has a rating of 20 tons at 4,000 lb. p.s.i. A full-flow filter is now available to eliminate 4-micron or larger impurities from power control and other hydraulic systems.

THE FAIREY AVIATION COMPANY LIMITED · HAYES · MIDDLESEX

Many of the world's most powerful fighting aircraft are powered by Armstrong Siddeley aero engines

SAPPHIRE

1 HAWKER HUNTER
2 GLOSTER JAVELIN
3 HANDLEY PAGE VICTOR
4 ENGLISH ELECTRIC P.1 (PROTOTYPES)
5 P.16 (SWITZERLAND)
6 SNCASO VAUTOUR (FRANCE)

J.65 SAPPHIRE

7 REPUBLIC THUNDERSTREAK F84F (U.S.A.)
8 REPUBLIC THUNDERFLASH RF-84F (U.S.A.)
9 MARTIN B.57 (U.S.A.)
10 NORTH AMERICAN FJ-4 FURY (U.S.A.)
11 GRUMMAN F.11F-1 (U.S.A.)
12 DOUGLAS A4D-1 SKYHAWK (U.S.A.)
13 LOCKHEED F-104 (U.S.A.)

VIPER

14 MACCHI M.B.326 (ITALY)
15 SNCASO TRIDENT (FRANCE)
16 HUNTING-PERCIVAL JET-PROVOST
17 IKARUS G.A. AIRCRAFT (YUGOSLAVIA)
18 JINDIVIK PILOTLESS TARGET AIRCRAFT
19 DASSAULT MIRAGE M.D.550 (FRANCE)

MAMBA

20 BREGUET VULTUR (FRANCE)
21 SHORT SEAMEW

DOUBLE MAMBA

22 FAIREY GANNET

PYTHON

23 WESTLAND WYVERN

ARMSTRONG SIDDELEY AERO ENGINES

COVENTRY & BROCKWORTH

Members of the Hawker Siddeley Group

The Importance of Time

—*in Aircraft Manufacture: A. Cdre. Banks' Lecture to the Royal Aeronautical Society* Part I

In a field as vast and diverse as the modern aeronautical scene it is almost impossible for any individual to obtain a truly balanced overall picture; yet such a picture has long been needed as a guide for future planning. This paper by A. Cdre. F. R. Banks, C.B., O.B.E.—a noted authority on engines and a director of the Bristol Aeroplane Co.—is certain to be received with relief by many in the industries of both Britain and America. We have the special permission of the Royal Aeronautical Society to reprint it in full, and the first part appears below. The lecture was given on October 17.

IN his introductory remarks A. Cdre. Banks said it was pertinent to consider how time and opportunity had been lost in the past rather muddled decade. His lecture, therefore, was not a technical paper on a specialized engineering subject; rather was it a discussion of this period and the way in which it was likely to influence Great Britain's future in military and civil aviation. After making the usual proviso that his opinions were his own and did not necessarily represent those of his company, the lecturer went on to discuss "Quantity and Quality."

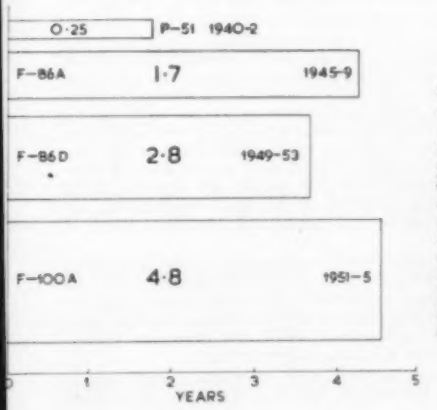
It is [he said] the new look in military aircraft since the last war, with the enormously increased (and still increasing) complexity in airframe, equipment and armament, which has made them so costly that they now absorb a large proportion of the available funds and manpower and set a severe limit to the numbers which can be ordered; and we run the risk of having only a token Air Force unless it is possible to devise some means of getting more of the things we really want.

Duplication of effort on the variety of aircraft and weapons at present under development should, wherever possible, be avoided or severely restricted to important projects having a number of "unknowns." Then there must be more certainty of having better-performing aircraft, and getting them quickly into service—although one would think that present Government policy is to reduce the Royal Air Force to near impotency, both in quality and strength. In quality of equipment the R.A.F. is about fourth after America, Russia and Sweden. In quality of personnel, it remains first-class.

The cause of our present condition is partly due to the inordinate time taken to issue an Air Ministry requirement where, literally, years have elapsed since the first thoughts, and not always the most timely aircraft or armament has been chosen. Also, the aircraft industry was not alive early enough to the implications of the new look in aircraft and failed to prepare itself for the much greater technical needs of the day.

The net result is that, due to more or less indiscriminate ordering, "off the drawing board," very little has reached the production stage. Even some of the more straightforward projects have failed to attain their performance standards and have either had to be ordered only in very limited quantity (to give the Royal Air Force something) or have been finally cancelled.

I say "off the drawing board," since it is my firm conviction that, in recent years, the wind tunnel has not been sufficiently or adequately used to avoid some of the troubles we have been in with prototypes.



Calendar time and engineering man-hours required from start of design to acceptance of the 200th unit for fighters by North American Aviation, Inc. The man-hours are in millions. Bare airframe costs are: P-51, $26,841; F-86, $121,000; and F-100, $486,000.

While I am aware that our bomber force must inevitably be much smaller than that represented by the U.S.A.F.'s Strategic Air Command and can provide only a limited contribution to the latter's strength, nevertheless, if we are to be fully effective, our V-Force should be similarly organized and always kept on a war footing—meaning intensive training and the active participation in "war" exercises, all involving considerable flying. If this is the right outlook, then the normal run of mishaps in training, together with the necessary reserve aircraft, will demand a fair-sized Force and one which, I think, would be considerably larger than that at present contemplated.

I do not pretend to know the answers to all these problems; but if it is argued that we want quality rather than quantity (since nuclear warfare will be short if not very sweet), can it be said that we have the quality or even the bare minimum in numbers—knowing the heavy losses of war, however short-lived it may be? Have we still to consider two additional types of bomber? It should now be possible technically to assess each and choose that showing the superior overall advantages and future "stretch" capabilities.

Operational Requirements: their Time and Timing.—Much thought and effort go into a new operational requirement, to get it to a state acceptable for translation and transmission to the industry. But with scientific and technical progress always a jump ahead of the final requirement, the difficulties of the Air Staff in coming to a firm and quick decision are clearly great; and all this, together with other "political" delays, risks the requirement becoming obsolete before the final design contract is issued and a line goes on the drawing board. In other words, it is the continuing flow of new ideas on aircraft and weapons that compounds the confusion of thought inevitably to delay decisions.

There has been considerable and unfavourable comment by the uninformed, also by the better informed, on the very heavy commitments of the aircraft industry and the time it takes to bring a fighter or bomber to production. And while a good deal of this criticism savours of hindsight (and this lecture is not in the nature of a witch-hunt), it seems to be quite commonly accepted that from seven to ten years are now required to design, develop and get a bomber to the production stage—but not necessarily into production.

The aim must be to cut this time factor almost in half if an aircraft is to be of any real use to the Royal Air Force; which can only be done by better research and experimental facilities and larger specialist technical and engineering staffs in the firms.

Our friends in the U.S.A. (with their vastly greater resources and large users) realized soon after the last war the significance of the then already increasing complexity of the military aircraft. As an illustration of this, a diagram [reproduced on the left.—Ed.] gives the trend of aircraft development in terms of engineering man-hours and calendar time required from the start of design to the acceptance of the 200th unit. I am indebted to North American Aviation for this data.

It will be seen that, in the case of the jet fighters shown, while the engineering man-hours increased from 1,700,000 for the F-86A to 4,800,000 for the F-100A, the difference in elapsed time between the two basic aircraft types was only a matter of months.

In my opinion, when a requirement is issued by the Air Ministry to the Ministry of Supply the latter should select only one or two firms to tender for it. The previous practice, of letting all likely bomber (or fighter) builders tender, is not practicable today since it ties up too many valuable technical staffs who should be doing other useful things, or re-distributing themselves and augmenting the technical and design departments of the more successful organizations.

But the first step in the ordering process of new weapon systems must be the creation of an adequate and efficient system of project evaluation. The assessment team for this purpose, which would be a mixed one of military and civil scientific personnel, should be located in the M.o.S. It must be the authoritative body, using the Royal Aircraft Establishment and others in an advisory capacity. Contracts should then be awarded, selectively, to those firms most likely to meet the commitments in reasonable time, avoiding

THE IMPORTANCE OF TIME . . .

those consolation prizes (in the form of prototype and limited-production orders) which have so often been given to the "second best."

As air defence, which is this country's prime consideration, is infinitely more difficult than the attacker's rôle, it is not now sufficient (except for the "old-fashioned" type of war) to order the odd fighter and leave it at that. Today, defence is a complex and highly integrated problem involving the combined directing or monitoring of piloted fighters and ground-to-air weapons against an attacker. Therefore, in formulating a requirement the weapon(s) only cannot be considered by itself, but the whole problem must be put to the aircraft industry to solve in the best way possible. In other words, the requirement might be couched as follows: "to evolve a complete weapons system to intercept and destroy at (say) 50 miles from shore an attacker flying at a Mach number of 2 at 70,000 feet."

This would involve completely co-ordinated "weapons system" groups within the firms tendering for the requirement, who would advise and then work hand-in-hand with the design staffs. The only alternative is to use an outside "weapons management unit" of the type existing in the U.S.A., such as the Ramo-Wooldridge and Rand Corporations.

In my opinion, it is impracticable arbitrarily to consider (as voiced in some quarters) a banding together, by Government decree, of the various and individual firms into larger units. In other words, it is a "sink or swim" philosophy which should actuate Government procurement, and the weakest must go to the wall or accept work from the successful firms—either to supplement the production rate by building the complete machine or as sub-contractors for components.

The Americans have used extensively, both for aircraft and engines, the "shadow" and sub-contracting schemes—the former idea originating in this country. For instance, I know of one (parent) engine firm in the States which reached a peak production, during the period of the Korean war, of about 750 jet engines per month with an administrative, engineering and production total of only twelve thousand personnel. This was made possible by buying from specialist firms completely machined components, such as bladed turbine wheels and shafts and combustion-ware, etc.; and when production was cut, "in one fell swoop," to 100 units, or less, per month, it did not result in complete disorganization within the company, and not too large a mass of labour was thrown out of work in one area. In fact, the company has managed to keep employment at a reasonable level by applying for, and being awarded, a U.S.A.F. contract for repairing its own engines.

Anyway, American labour does not resist going to other areas for work so much as does our own, although I agree that no one wants to change his home if it can possibly be avoided. But there has to be some flexibility in the movement of labour if we are to be competitive in world trade.

I understand that it is the deliberate policy of the American Department of Defense to "shadow" engine manufacture in peacetime, to avoid large manpower peaks and depressions in the parent companies and to have a war-potential source of supply. For instance, the Pratt and Whitney J57 is being manufactured by the Ford plant at Chicago and the Wright J65 (Sapphire) has also been built by Buick.

To return to my subject, and in retrospect: we have not anticipated or subsequently taken all steps to meet the increasing technical and engineering demands of modern aviation, and some of the more technically capable firms have become overloaded with projects while others seem to have little to offer.

If blame attaches to anyone for this lack of appreciation, then the industry must share it with the Government departments concerned; for it is the industry who should have been on the alert and prepared itself to meet these heavier and much more highly technical commitments. In fact, the industry appears only recently to have woken up to the fact that the wind tunnel is an indispensable piece of equipment—for much more intensive use than in the past, to ensure that the aircraft prototype, when built, will perform and handle as the designer intended without major and time-consuming modifications becoming necessary. But all of us, in Government departments and in the industry, must share the responsibility for the present state of affairs.

Incidentally, a major cause of future delay in producing satisfactory supersonic prototypes on time can well be in the making of the wind-tunnel model, unless there are new ideas on its design and manufacture. These models require considerable skill in both design and manufacture; and some have taken a full year or more to make, being virtually tool-room jobs.

My experience, of about thirty years, has indicated that the successful aircraft and engine firms have usually been those which anticipated a need and came up with such an attractive proposal that it often formed the basis of an official requirement. This was certainly the case before and during the last war, but is virtually impossible nowadays, due to the prohibitive cost of embarking upon any military project as a private venture.

An important point, and one not always appreciated by those outside the armaments industry, is that there is really no such thing as a firm "backlog of orders" when holding Government contracts, since the Government (for political or other reasons) can reduce or cancel completely any such contract with little or no prior notice. This is another reason why firms tend to get overloaded with various projects; and they have to be very shrewd, or very good at crystal-gazing, to know whether or not they are on a good thing. Therefore, they generally take on a number of projects, one or two of which, they hope, will eventually get into production.

There is lack of a good assessment team and a statistical and logistical section within the M.o.S. to analyse the results of a requirement, from the brochures submitted by the industry, and to put a capability factor on each firm. I am aware that there already exist projects and plans sections (AD/RD Projects and T.D. Plans) who, with the various technical directorates, assess the designs and advise on their technical merits, etc.; but these sections are hopelessly understaffed and do not have the standing or authority which should be theirs.

What I wish to see is a single self-contained team whose job it is not only to assess new designs but to analyse the firms' capability to design, develop and produce aircraft or their equipment at the desired rate. And, incidentally, there is no need for the separate "empires" of aircraft and guided weapons within the M.o.S. These should be combined, in the interests of economy in personnel and funds.

In the last war, the Ministry of Aircraft Production had a statistical and planning department which, for some reason or other, was afterwards disbanded. It is urgently required today, in order to give the lead on the proper use of manpower—to assess the man-hours needed to build a prototype and to vet the industry's productive capacity in these terms.

While a relatively small firm with limited but capable technical and engineering staff can design and manufacture a satisfactory prototype, in due course, much more is necessary; and there should be greater certainty than there appears at present of getting a successful prototype and clearing it to production in reasonable time. By "reasonable time" I mean five years and not seven or ten. A high-supersonic aircraft may, however, take up to ten years. It may be argued that the lack of proper facilities and equipment make this reduction in time impossible of achievement, but we cannot otherwise hope to compete in world aviation or afford the wasted effort in achieving the obsolete.

For the very reason that an aircraft takes so much effort to design and build, it is mandatory that any firm tendering for a contract has full facilities for completing that commitment. In other words, it should have adequate technical and engineering strength and testing facilities, with aerodynamic, mechanical and all necessary systems' test rigs, to ensure that the prototype will have the minimum of "tricks" when it flies, and a high degree of operational reliability built into it from the start.

Military Procurement.—In the case of military aviation in recent years, the Air Ministry (Air Staff) and the M.o.S. have suffered from "restrictive practices," in that a requirement does not go from the former direct to the latter, for transmission to the industry, but has first to be considered by the Defence Research Policy Committee (D.R.P.C.), the Air Defence Committee and, I believe, the Cabinet Defence Committee. It will be appreciated, therefore, that the chance of any decision being made at all is probably very small, and the chance of the right decision being made is practically zero. Even before these hurdles were placed between the Air Ministry and the M.o.S., the length of time taken by the Air Staff to issue a requirement was largely due to the delays in getting Treasury approval.

When considering the various projects which have been initiated since the end of the war one cannot avoid the conclusion that the Air Ministry has not always had sound technical advice regarding the types of aircraft to order; and, presumably, it was such advice that caused two more-advanced bomber prototypes to be put in hand. But, to get something more quickly, a less ambitious specification was implemented, i.e., the Valiant, which at the time of its conception represented a good start to the bomber programme. But still more chilly feet caused the Sperrin to be ordered, which was not, I believe, an Air Staff requirement. In fact, some of the projects of recent years bear the stamp of "hunches."

While the Sperrin might have been conventionally reasonable, there was no need for both machines; and the relative merits of delta and crescent wings could surely have been resolved in the wind tunnel. If it is contended that we then had no suitable wind tunnel to evaluate these designs, I think our American friends would have offered their facilities if approached.

All this is past history, but I mention it because we still appear to be living in the era between the two wars and have yet to reach

THE S.E.P. 2 AUTO-PILOT

WILL TAKE OVER KLM's VISCOUNT 803's

A superb combination — Viscount 800 comfort matched with the smooth flight path made possible by the Smiths S.E.P. 2 Automatic Pilot. Precise response to flight deviations, accurate locking to barometric height, plus the other special features provided by this outstanding Auto-Pilot, help to ensure that modern high speed aircraft operate at their efficient best. The S.E.P. 2 — which has already been adopted by 12 major operators for their modern fleets — is the first British equipment of this type to be specified by KLM.

SMITHS AIRCRAFT INSTRUMENTS

The Aviation Division of S. Smith & Sons (England) Limited

CRICKLEWOOD • LONDON • NW2

S.E.P. 2 Flight panel.

SMITHS

S.E.P. 2 AUTO-PILOT

SOLE SALES CONCESSIONAIRES FOR KELVIN & HUGHES (AVIATION) LIMITED, BARKINGSIDE AND BASINGSTOKE

TGA SM27

3.

A New Proving Ground

Dunlop is constantly looking ahead to improve the Company's facilities for testing new aviation equipment, and in this connexion a new giant dynamometer has been installed in one of the Aviation Division's laboratories at Coventry. The new machine permits a closer simulation of actual landing conditions and permits tyres, wheels and brakes to be tested to meet the full requirements of all the leading airworthiness authorities. During brake tests, the weight of the inertia flywheel is adjusted to give a Kinetic Energy value equivalent to that of the aircraft at landing speed. The tyre is then loaded against the rim of the rotating wheel and the brake applied until the flywheel is brought to a standstill.

This console controls the test procedures and records the test data.

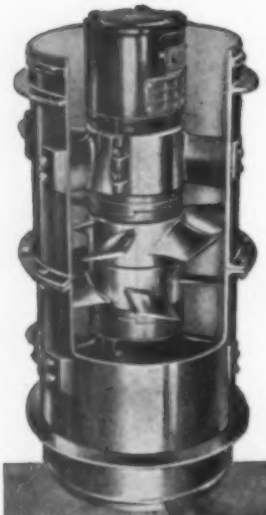
A general view of the Dynamometer with one of the loading pneumatic rams in the foreground.

DUNLOP

—dependable equipment for the aviation industry

DUNLOP RUBBER CO. LTD (AVIATION DIVISION) · FOLESHILL · COVENTRY

6H/623



AIRCRAFT FANS for CABIN VENTILATION

Airscrew 7" diameter contra-rotating fans for cabin-air re-circulation and small centrifugal blowers for windscreen de-misting are used in the highly successful Vickers Viscount.

and WINDSCREEN DE-MISTING by AIRSCREW

Windscreen de-misting and cabin-air re-circulation are only two of the vital duties performed by the ancillary fans that Airscrew have designed for most modern British aircraft. For nearly 30 years Airscrew have designed and produced fans and propellers for all kinds of aircraft. If you have a fan problem, Airscrew have the specialised knowledge and experience to help you answer it.

Design approved by M.O.S. and A.R.B.

THE AIRSCREW COMPANY & JICWOOD LIMITED
WEYBRIDGE, SURREY *Tel: Weybridge 2242/6*

Getting to grips

with the problem of supplying yourself with nuts and bolts in steel, stainless steel and alloys, with turned components such as studs, tensioners and turnbuckles, or with special parts including pipe joints and small rod assemblies, all to your own special requirements, A.I.D. and A.R.B. . . . the answer to this problem is, if you want things made beautifully simple . . .

MEMBER OF THE OWEN ORGANISATION

Another member of the Owen Organisation, Electro Hydraulics Ltd., Warrington, specialises in the design and production of undercarriages and hydraulic equipment.

AVIATION DIVISION, RUBERY OWEN & CO. LTD. P.O. BOX 10, DARLASTON, WEDNESBURY, STAFFS. TELEPHONE: JAMES BRIDGE 3131

THE IMPORTANCE OF TIME . . .

the stage of formulating an advanced and logical programme of research and development in line with the leading countries.

To speed up the clearance and issue of a requirement, the Ministry of Defence, only, as the top defence authority, should be brought into the military procurement picture, to assess and confirm the need, in the light of all other requirements, and then to clear its financing with the Treasury without delay.

The apparent intention of drastically reducing the size and scope of the Armed Forces of this country might well allow the Admiralty (which mostly looks after its own procurement) and the War Office to handle their own non-aviation projects directly with the contractors concerned. But in the case of military aviation, the disproportionately large and costly effort which has to go into the whole aircraft procurement process, all of which is in a continual state of scientific and engineering flux, demands special supervision; and the engineering effort involved in getting a prototype manufactured and fully developed is many times that of producing such things as ships and tanks, etc.

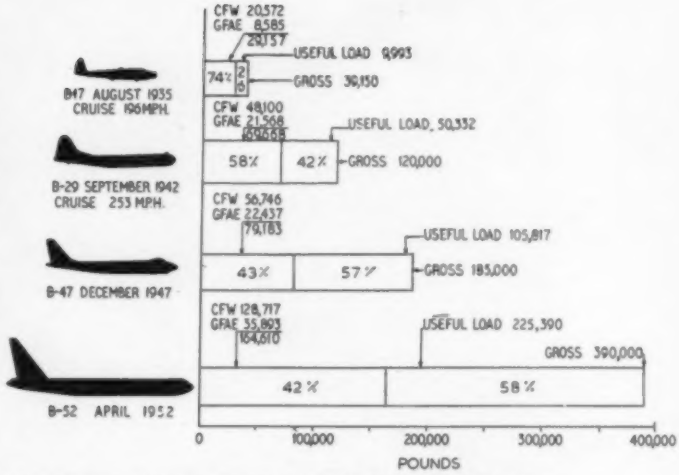
Therefore, it might be feasible to consider the M.o.S. as a specialized kind of Ministry of Aviation. It could then be considerably reduced in size and so become more closely knit.

The "new look" M.o.S. or Ministry of Aviation, if formed, should be regarded as a top-level administrative and technical organization which could offer jobs at competitive salaries to a few senior administrators from the outside, to take key positions in the engineering and production sections. Since Ministries do not build things, but only cause them to be built, we cannot afford to rob the industry of too many able people or risk putting those available into positions which do not allow full use of their skill and experience. However, a few capable administrative engineers would be invaluable to such a department.

In the case of civil aviation, and because of the urgent need for the country to be up with the leaders in air transport, there should be a more direct procurement link between the two national airlines (B.O.A.C. and B.E.A.) and the aircraft industry. But, to contribute effectively to any future new look in civil aviation, the technical and procurement departments of the airline companies would have to be considerably strengthened.

It is impracticable to consider entirely eliminating the M.o.S. (or Ministry of Aviation) in the procurement processes of civil aircraft, since this Ministry is responsible for all research and development in aviation as a whole, including engines; which latter generally evolve as a result of a military need, are costly and difficult to develop, and should for economy of effort and financing remain with the Department.

Whatever the organization, or reorganization, I consider it most necessary that the operational requirements team at the Air Ministry and those concerned in the M.o.S., whose job it is to submit all requirements to the industry, should be housed together in the same building, under one and the same controller, that they may see each other daily and discuss together the various points of a requirement as it is being prepared. At the present time, the relevant sections and departments concerned are sufficiently far apart for this to be difficult—which tends towards parochial viewpoints.



Characteristics of the prototypes of four Boeing bombers; C.F.W. is contractor furnished weight and G.F.A.E. is government-furnished airborne equipment. Quantitative production data are tabulated below.

If I have laboured the importance of speeding the aircraft requirement, together with the need for realistic assessment of the firms' capabilities to design, develop and produce, it is because I feel so strongly that we must take less time to do things and have a better sense of timing; and we can only achieve this if we exercise superior technical judgment in what to go for and concentrate more effort upon each project.

Time and timing are the essence of success in aviation.

In order not to burden this lecture with statistical data, but because it is of interest and is worth close and concentrated study, I have reproduced in the Appendix some data on bomber production received from the Boeing Airplane Company. I have their permission to use this and record here my grateful thanks for the material.

I have chosen to record these various American data (North American and Boeing) because the two firms concerned have produced more fighters and bombers, respectively, than any others.

(To be concluded)

APPENDIX II (Abridged)

Tabulated data for production of Boeing bombers. In each case the cost figures are indexed to 1952 rates; the two additive figures are, in each case, non-recurring and recurring costs, with all experimental and non-recurring cost in first position.

DOLLARS PER POUND OF CONTRACTOR FURNISHED WEIGHT

	B-17	B-29	B-47	B-52
Prototype	795.4	1,133.83	2,149.4	1,954.0
Average 1-10	79.5+43=122.5	113.4+52.0=165.4	214.9+80.0=294.9	195.4+109.0=304.0
1-50	15.9+39= 54.9	22.7+34.3= 57.0	43.0+51.0= 94.0	39.1+ 55.0= 94.1
1-100	8.0+35= 43.0	11.3+27.7= 39.0	21.5+41.0= 62.5	19.5+ 43.0= 62.5
1-500	1.6+23= 24.6	2.3+16.2= 18.5	4.3+24.0= 28.3	3.9+ 25.5= 29.4

DOLLARS PER POUND OF USEFUL LOAD

	B-17	B-29	B-47	B-52
Prototype	1,722.0	1,083.5	1,279.5	1,132.8
Average 1-10	172.2+113.0=285.2	108.4+59=167.4	128.0+52.3=180.3	113.3+68.3=181.6
1-50	34.4+102.0=136.4	21.7+42= 63.7	25.6+36.8= 62.4	22.7+40.4= 63.1
1-100	17.2+ 96.0=113.2	10.8+36= 46.8	12.6+31.4= 44.2	11.3+33.3= 44.6
1-500	3.4+ 70.5= 73.9	2.2+24= 26.2	2.6+20.7= 23.3	2.3+21.7= 24.0

DOLLARS PER POUND OF USEFUL LOAD PER MILE PER HOUR

	B-17	B-29	B-47	B-52
Prototype	8.78	4.283	1.978	1.666
Average 1-10	0.88+0.57=1.45	0.428+0.233=0.661	0.198+0.081=0.279	0.167+0.100=0.267
1-50	0.19+0.52=0.70	0.086+0.166=0.252	0.040+0.057=0.097	0.033+0.059=0.092
1-100	0.09+0.49=0.58	0.043+0.142=0.185	0.020+0.049=0.069	0.017+0.049=0.066
1-500	0.02+0.36=0.38	0.009+0.095=0.104	0.004+0.032=0.036	0.003+0.032=0.035

Czechoslovak VSM.40 Démant single-seater, pictured at the World Gliding Championships. Revised championship results are reported below.

CLUB AND GLIDING NEWS

REVISED programme of Wednesday-evening activities at the Kronfeld Club, 74 Eccleston Square, London S.W.1, includes the showing of John Furlong's colour film of this year's World Gliding Championships on October 31. The following Wednesday, November 7, Maurice Imray and Harold Best-Devereux will talk on the recent fuel-consumption wager involving an Auster J.4 and a Triumph T.R.3 (the pilot's account of this contest appeared in *Flight* of October 5, 1956). Both begin at 8 p.m. The World Gliding Championships film, following its showing at the Kronfeld Club, will be available for hiring from the British Gliding Association by gliding clubs and other interested groups.

ACCORDING to the Surrey Flying Club's *Quarterly Gazette*, the Tiger Club is planning to hold an air race meeting at Sandown, Isle of Wight, on May 26 next year. Also proposed is an aerobatic competition for pilots of limited experience, which will probably take place on May 6 at Sywell. For this competition, it is stated, the de Havilland Aircraft Company is presenting a challenge trophy; the occasion will be in celebration of the 25th anniversary of the Tiger Moth's original C. of A. in 1932.

THE Fair Oaks Cup Competition, a navigation exercise, was won recently by J. E. Forbat of the Vickers-Armstrongs club. Some reasons for other competitors' lack of success, summarized by C. F. I. Arthur in the current newsletter of the Fair Oaks Aero Club, were: 1, failure to take the correct map; 2, failure to interpret clues correctly; 3, poor map reading; 4, losing maps or orders overboard; 5, poor airmanship. A club dinner has been proposed and is under consideration; September's paid flying amounted to 542 hours.

PRESUMABLY judged equivalent (in value or effect) by the Plymouth Aero Club are 40 minutes' flying time and a bottle of whisky or gin—alternative prizes in the club's monthly draw. Following the recent Plymouth/Exeter breakfast patrol at Exeter, a return patrol was planned for Sunday last. Supreme enthusiasm quoted in the current club newsletter is that of one member who regularly travels to Roborough from "wherever he happens to be working. And last month that meant a trip from the Midlands." This 200-mile example of keenness was rewarded on his arrival with zero visibility and continuous solid rain.

R.Ae.C. PILOTS' CERTIFICATES, JULY-SEPTEMBER, 1956

No.	Name	Cl.	Date	No.	Name	Cl.	Date
28,771	J. R. Chapman	2	4/7/56	28,783	P. K. Arbuthnot	*2	8/8/56
28,772	A. J. White	2	5/7/56	28,784	A. R. Carvell	1	17/8/56
28,773	P. J. M. Surridge	4	5/7/56	28,785	J. H. H. Brunt	2	28/8/56
28,774	D. G. W. Robertson	1	11/7/56	28,786	A. J. Kearns	2	30/8/56
28,775	D. H. Clarke	1	11/7/56	28,787	J. P. von Straaten	3	30/8/56
28,776	G. C. Marler	1	19/7/56	28,788	R. V. Lacey	1	5/9/56
28,777	A. M. R. Russell	3	28/7/56	28,789	P. Elliott	2	5/9/56
28,778	H. S. Cartmell	3	28/7/56	28,790	F. P. A. Cocks	3	12/9/56
28,779	L. M. Berner	2	30/7/56	28,791	K. Kneen	2	20/9/56
28,780	H. Gilliver	1	30/7/56	28,792	E. R. Hill	1	24/9/56
28,781	R. D. Harvey	2	4/8/56	28,793	H. A. R. Bucknall	4	27/9/56
28,782	G/C. W. R. Beaman	1	4/8/56	28,794	Miss J. M. Wood	1	27/9/56
				28,795	H. J. Judd	3	27/9/56

RECORD total of flying hours flown by the Lancashire Aero Club at Barton during September was 278. Target for the current club year (from June 1) is 1,600 hr. Prizewinners in last month's contests were: Pemberton (Junior) Landing Competition: 1 G. Gamble, 2 N. Taylor, 3 E. Lacey; Rodman (Senior) Landing Competition: 1 J. Hill, 2 M. Barnes, 3 E. Kitchen; Crossley Navigation Competition: 1 F. Emery, 2 M. Barnes, 3 J. Simpson.

RECENTLY reorganized, the Iranian Civil Aviation Club, Jale Street, Tehran, Iran, now wishes to extend its collaboration with other countries by means of correspondence with representatives of British Flying Clubs. Mr. H. Ramtin, editor of the club's journal *Parvaz*, is particularly interested in exchanging club periodicals and in receiving other news of club activities in the United Kingdom and elsewhere.

AMENDED results of this year's World Gliding Championships, recently published by the French Aero Club, include the following list of the top twelve pilots in the single-seater class:—

1, MacCready (U.S.A.), 4,903 points; 2, Juez (Spain), 3,807; 3, Gorzelak (Poland), 3,576; 4, Saradic (Jugoslavia), 3,435; 5, Ivans (U.S.A.), 3,366; 6, Nietlispach (Switzerland), 3,116; 7, Ara (Spain), 3,097; 8, Reitach (Germany), 3,042; 9, Wills (U.K.), 3,031; 10, Ortner (Argentine), 2,977; 11, Stephenson (U.K.), 2,965; 12, Persson (Sweden), 2,887.

These changes from the original list, reportedly caused by "wrongly estimated distances," have resulted in Wills moving up from 10th to 9th place, and Stephenson dropping from 6th to 11th.

ONE of the most useful and concentrated doses of gliding sense now available is the 70-page instructors' manual published by the British Gliding Association. Written by Ann and Lorne Welch—a guarantee of quality from the start—a revised second edition with the title *Flying Training in Gliders* is now on sale at 5s. The main chapters are concerned with the various stages from a pupil's first flight to aero-towing and aerobatics, and each is divided, logically, into three parts. Firstly, the principles of flight and other factors involved in the particular exercise are discussed; secondly, an outline of air instruction is given; and the final sections contain additional advice to instructors. Further chapters concern the techniques of instruction, methods of training and club test-flying.

"The purpose of the book," the introduction states, "is to help the gliding instructor to acquire knowledge before he starts instruction, and afterwards to serve him as a reminder of the principles and methods involved. It is also intended to be of use to the pilot who wants to improve his flying." Instructors are presumably already aware of this book; the main significance of this new edition lies perhaps in its less-obvious value to *all* glider pilots. The manual is obtainable from the B.G.A. at Londonderry House, 19 Park Lane, London, W.1.

Aspects of the Agricola

"Flight" photographs

These "Flight" photographs, taken during C. M. Lambert's air test of the Auster Agricola (his account appeared last week) show the machine at work and play. At the head of the page and at right, the author presents it from ahead and peeling off. At left and above the hopper is loaded and the fertilizer spread across the airfield. The loading hopper would, in the field, be mounted on the supply lorry and the aircraft's engine would not be stopped.

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Mr. A. Pearcy's photograph of a Mercator at Blackbushe.

I am enclosing a photograph taken a few months ago at Blackbushe of a Martin P4M-1Q Mercator, serial no. 122209, from a U.S. Navy squadron based in North Africa. A close look at the photograph will reveal another P4M-1Q parked in the background.

I understand from the books that only nineteen of this type were ever built, and several have been destroyed since in various incidents.

Bovingdon, Herts. A. PEARCY.

I CAN claim seeing a Mercator. These aircraft frequently visit the U.S. Navy base at Blackbushe and two P4M-1 Mercators took off from there on September 30, serial numbers 124372, U.S. Navy code PS-4 and 122209, code PS-2.

Sandhurst, Surrey. A. ALEXANDER.

[A number of other readers have written to similar effect—Ed.]

Memories of a 1½-Strutter

THE articles about historic military aircraft appearing in *Flight* are most enjoyable and nostalgic and I read with particular interest Part II of No. 14 written by Mr. J. M. Bruce in your October 5 issue dealing with the famous Sopwith 1½-Strutter. One of these was carried after the formation of the R.A.F. on the forward superimposed turret of H.M.S. *Emperor of India*, 2nd flag ship of the 1st Battle Squadron, Grand Fleet, in which I was serving as a midshipman, R.N.

On the morning of November 21, 1918, the date on which the German High Seas Fleet surrendered to the Grand Fleet, on the order of the late Captain Charles Royds, R.N. (later Commissioner of the Metropolitan Police), our Strutter was used to fly to East Fortune the dispatches of the *Daily Express* reporter who was in our ship to report this historic occasion. The pilot was Lt. Bostock and his observer was 2nd Lt. Daniels, R.A.F. After the signal for knocking out the quick release pin had been given, the rotary engine dropped a few hundred "revs" and Bostock and his observer nearly finished up in the sea.

We took the German Fleet from its temporary anchorage off Inchkeith to Scapa Flow later in November 1918, and on the voyage northwards encountered very rough seas and high winds. Our Strutter was much battered in her exposed position and was removed after arrival at Scapa. We never saw her again.

Mr. Bruce refers in his article to the "battle cruisers" *Queen Elizabeth* and *Barham*: in fact these were battleships of the 5th Battle Squadron, Grand Fleet, and were not battle cruisers.

I look forward keenly to the next series of articles on historic military aircraft and wish continued success to your excellent publication, of which I have been a regular reader for over 40 years.

Brighton 1, Sussex. J. A. LESLIE MOORE.

Mach-proof Market Gardening?

MUCH antagonism has grown up in recent years among the ranks of market gardeners against high-speed pilots on account of the fact that the latters' efforts to exceed Mach 1 appear often to result in a trail of broken cucumber frames across the country.

Understandably annoyed at this sort of thing, the gardeners have complained bitterly and demanded that steps be taken to put a stop to it. They are unhelpful in suggesting a means of doing this without interfering with the training of the Royal Air Force, again understandably, since they are merely concerned with safeguarding their cucumber frames in time of peace—though possibly they might be willing to hand over that responsibility to the R.A.F. if war broke out.

In fact, the problem appears to have been thrown complacently into the joint lap of the Royal Air Force and the aircraft industry, without anyone so much as suggesting that a possible solution lies in attacking it from the other side.

Few things are impossible nowadays; it might be efficacious at least to conduct an investigation into the possible manufacture of a glass that will withstand the shock-waves set up by an aircraft passing Mach 1.

It might, at any rate, serve to obviate the dangerous possibility of aviation acquiring a persecution complex.

R.A.F. Rufforth, Yorks. M. C. HALL, Pilot officer.

Not-so-Rare Bird

I WAS interested to read Ch./Obs. N. R. Yates' letter about sighting a Martin Mercator over Southampton. Although I did not see that particular aircraft, I was very surprised to see no fewer than three Mercators on the ground at once when I passed Blackbushe in August 1954, for I believe that only 19 were ever built.

Harrow, Middx. P. M. BAGGALEY.

WITH reference to the letter in your issue of October 12 headed "Rare Bird," I would like to doubt very much the rarity of the Martin P4M-1 Mercator in the south of England. Indeed, during the last year its presence has increased, as the type is a frequent visitor to Blackbushe Airport, and I personally have seen as many as four of this type on the ground at once at this aerodrome.

Gallic Logic?

MAY I suggest, looking at various photographs of airline pilots seated at their controls, that aviation engineers are mad? You shall notice that in many transport planes, the instruments, made to be watched by the *eyes*, and which ought to be in the line of sight, are very low at the level of the *knees*; and the things which must be reached by *hand* not at the level of the hands, but the level of the *eyes*. Is it not absurd?

Planes in 1956 are built with bolts, supplied by specialized firms. And nuts, the engineers themselves.

Paris, 8e. HERVÉ LAUWICK, Editor, *Noir et Blanc*.

Light Twins

THE caption to your photograph of the Aero Commander 560A F-BGSD (*Flight*, October 5) states erroneously that this is the first of this type to be delivered to France. At least two others have been delivered there: Type 510s, N4109B (which became F-BBDY) and NZ718A, both bearing American registrations for the ferry flights and because they both had previously been owned in the U.S.A. Both were ferried through Prestwick, as was F-BGSD.

Your recent plea for a British (not "English") light twin would seem to be logical in view of the numbers passing through this country, *via* Prestwick and thence to Paris, in many cases on delivery to owners in Europe and Asia. So far, here is this year's score: Five Commanders (one 520, two 560s and two 560As); four Twin Bonanzas, one 310 and two Apaches. Last year, no Commanders but one Twin Navion (in addition to the other types) were delivered to "this side." Though these numbers are not great in themselves, there would be a demand for a twin built in this country, with no payment in dollars necessary and no long delivery flights (to Europe, at any rate).

Glasgow. DUGALD CAMERON.

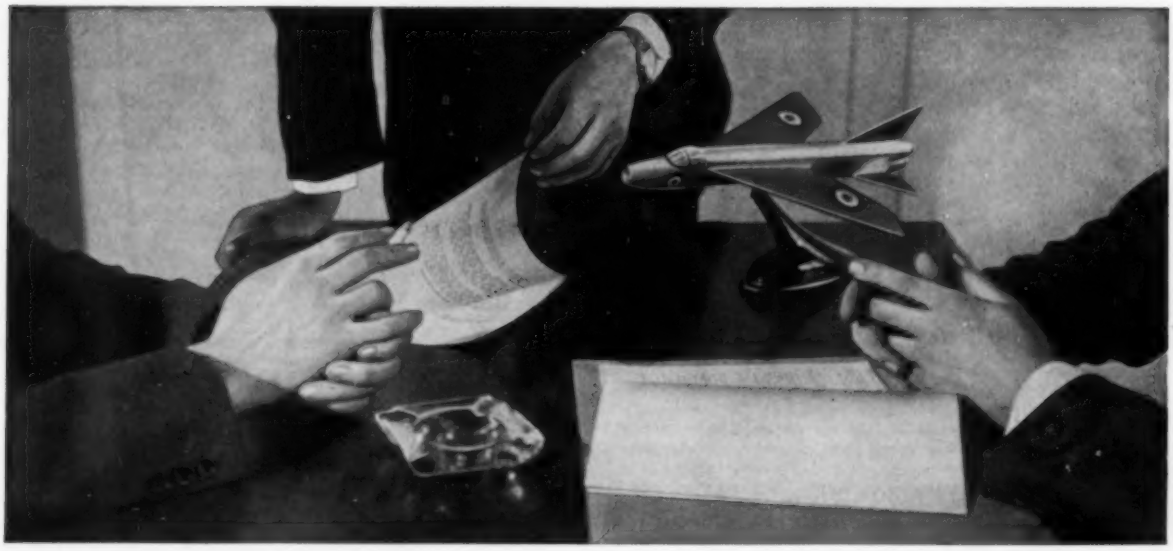
[Our caption was based on information supplied by the Aero Design and Engineering Co., who stated that this was the first 560A Commander to go to France.—Ed.]

FORTHCOMING EVENTS

Oct. 25-26. Aircraft Electrical Society: Annual Display, Los Angeles.
Oct. 26. Aerauto Association: Dinner and Dance.
Oct. 26. Kronfeld Club: Annual General Meeting.
Oct. 26. College of Aeronautics: Tenth Anniversary Dinner, London.
Oct. 30. R.Ae.S.: Graduates and Students Section: "Nuclear Power for Aircraft," by E. P. Hawthorne.
Oct. 31. British Institution of Radio Engineers: Annual General Meeting and Presidential Address.
Oct. 31. Institute of Welding: Annual Dinner.
Nov. 1-2. Institute of Welding: Joint Meeting with the Netherlands Welding Society.
Nov. 2. Helicopter Association: "Development of the Skeeter Helicopter," by T. D. Nisbet, A.R.Ae.S.
Nov. 6. R.Ae.S.: Main Lecture: "London Airport," by Air Marshal Sir John D'Albiac, K.B.E., C.B., D.S.O.

R.Ae.S. Branch Fixtures (to November 7).

Oct. 30, *London Airport*, "Design Problems of the Large Helicopter," by Dr. G. S. Hislop. Oct. 31, *Weybridge*, R. K. Pierson Memorial Lecture. Nov. 6, *Boscombe Down*, "High Speed Flight Problems," by R. F. Creasey. Nov. 7, *Luton*, "The Prestwick Pioneer," by N. J. Capper; *Bristol*, "The Dawn of Aerodynamics," by J. L. Pritchard.



'...but our most urgent need is—MORE STAFF'

(Report of a meeting between the Chief Engineer, his Technical Assistant and his Personnel Officer)

C.E. As I see it, the problem is how to attract people by conveying some idea of our future plans without giving away secret information.

P.O. Haven't we first got to convince them that ENGLISH ELECTRIC intend to push ahead with the next generation of aircraft?

C.E. Surely they don't think that after all the work we've done on supersonic flight in general, and the P.1. in particular, we are just going to sit back and go out of business!

P.O. If we can't talk about the aircraft we are planning to build can we say something about the equipment we've got or are going to get?

T.A. For example, is it permissible to point out that our new tunnel has been designed for speeds up to Mach 4, and let people draw their own conclusions?

C.E. There's no reason why we shouldn't. And we can mention the new plant for testing structures and equipment at high temperatures non-stop for hours at a time. In fact we ought to talk about all our test installations.

P.O. Provided we don't thereby give people the impression that we are a great octopus in which the individual is swallowed up.

T.A. I've never yet heard a research man complain about the amount of equipment or the size of the resources at his disposal!

C.E. True, but it's worth pointing out that this Division is a self-contained affair of very reasonable size, with a colossal parent organisation behind it.

P.O. Which of course brings in all the other advantages like security of employment, opportunity for advancement, decent working conditions and help with the accommodation problem.

C.E. And remember we want all grades of D.O. and engineering staff—mechanical and hydraulic engineers, heat-transfer experts, metallurgists, physicists, aero-dynamics folk—the lot. We must look outside the aviation industry as well as inside. See if you can get something on paper for me.

'ENGLISH ELECTRIC' aircraft

Partners in Progress with Marconi's and Napier in THE ENGLISH ELECTRIC GROUP

FOR FURTHER INFORMATION WRITE TO DEPT. 1716F, C.P.S., MARCONI HOUSE · 336 STRAND · LONDON · WC2

WESTON

AIRCRAFT INSTRUMENTS

The Model S.122 Form 4 is a high pressure transmitter having ranges of from 0-400 p.s.i. up to 0-6000 p.s.i. The transmitter is contained in a die-cast aluminium case and consists basically of a special form of Bourdon tube which, when under pressure, moves laterally, causing a change in the position of a contact arm wiping across a resistor.
The resultant variations are led away from the transmitter through a three-pin plug, and are fed to a ratiometer indicator operating from the nominal 24 volt supply. The instrument is substantially independent of variations in supply voltage. The working life of this transmitter is unaffected by large and high frequency pulsations in the pressure supply.
Other forms available for pressures of 40 to 120 p.s.i.

SINGLE PHASE AND POLYPHASE WATTHOUR METERS
SYNCHRONOUS TIME SWITCHES
SYNCHRONOUS MOTORS AND MOTOR UNITS

SANGAMO WESTON

PANEL & SWITCHBOARD INSTRUMENTS
D.C. Moving Coil, A.C. Rectifier, H.F. Thermocouple, A.C./D.C. Moving Iron
PORTABLE INSTRUMENTS
D.C. Moving Coil, A.C. Rectifier, H.F. Thermocouple, A.C./D.C. Moving Iron, A.C./D.C. Dynamometer
LABORATORY STANDARD INSTRUMENTS
D.C. Moving Coil, A.C./D.C. Dynamometer

CURRENT TRANSFORMERS · FREQUENCY METERS · ALL-PURPOSE TEST SETS AIRCRAFT INSTRUMENTS · RATIOMETERS TACHOMETERS · WESTON STANDARD CELLS · ELECTRICAL THERMOMETERS "PHOTRONIC" PHOTO ELECTRIC CELLS PHOTOMETERS

SANGAMO WESTON LIMITED
ENFIELD · MIDDLESEX
Telephone: ENField 3434 (6 lines) & 1242 (6 lines) *Grams:* Sanwest, Enfield

Scottish Factory: Port Glasgow, Renfrewshire Port Glasgow 41151
Branches: London, CHAncery 4971 Glasgow, Central 6208; Manchester, Central 7904 Newcastle upon Tyne, Newcastle 26867 Leeds, Leeds 30867; Liverpool, Central 0230 Wolverhampton, Wolverhampton 21912 Nottingham, Nottingham 42403 Bristol, Bristol 21787 Southampton, So'ton 23328 Brighton, Brighton 28497

SW/18

THE FIRST WORD IN FASTENER EFFICIENCY

DZUS

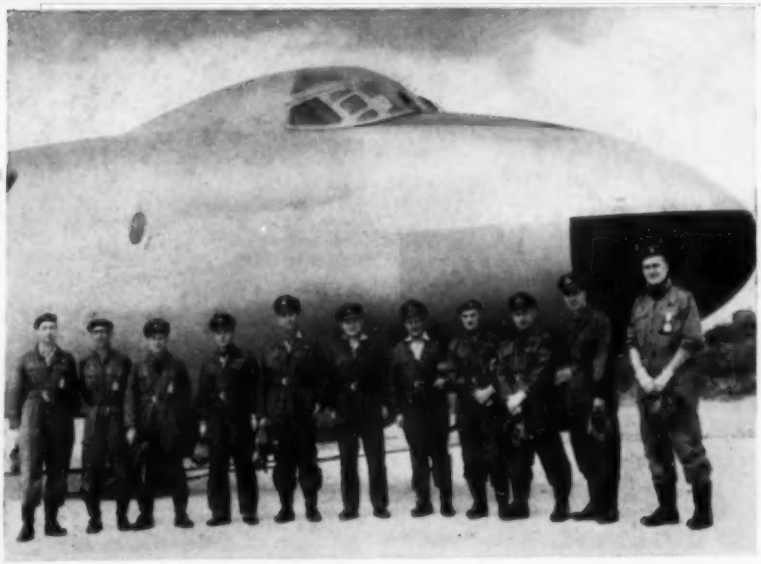
THE LAST WORD IN TENACITY & SIMPLICITY

DZUS FASTENERS for 101 fastening applications

DZUS FASTENER EUROPE LTD., FACTORY ESTATE, GUILDFORD RD., FARNHAM, SURREY.
Sales Agents in U.K. THOMAS P. HEADLAND LTD., 164-168 WESTMINSTER BRIDGE RD., LONDON S.E.1.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News



Members of the R.A.F. Atomic Task Force standing in front of the Valiant which dropped the nuclear weapon at Maralinga recently. Left to right: F/L. E. Stacey, P/O. G. W. Ford, F/O. G. B. Spencer, F/L. J. A. Ledger, S/L. E. G. J. Flavell, G/C. S. W. B. Menaul, Task Force Commander, F/L. R. N. Bates, F/O. J. T. Mitchell, P/O. F. Coulton, F/O. K. R. Edmonds, F/L. J. F. S. Finnis.

Standard Awarded

IT was announced in the *London Gazette* of October 16 that the Queen has approved the award of a Standard to No. 230 Sqn.

Proving Flight to Singapore

PREPARATORY to opening a scheduled service to the East, a Comet 2 of Transport Command is making a 16,200-mile proving flight to Singapore and back. This flight is the longest yet to be made by a Comet in R.A.F. service. A.V-M. A. McKee, A.O.C-in-C. Transport Command, is acting as co-pilot and the captain of the aircraft is W/C. B. D. Sellick, C.O. of No. 216 Sqn. From Lyneham, Wilts, the aircraft is flying *via* El Adem, Aden and Ceylon, the longest stage being the 2,420 miles across the Indian Ocean to Ceylon.

No. 216 Sqn. has been concerned in military transport flying for the past 40 years. Before taking up its duties as the first Comet squadron, it was operating Valettas in the Canal Zone, where it received its Standard.

Atlantic Search

SHACKLETON crews of R.A.F. Coastal Command have been highly praised by the U.S.A.F. for the part they played in the search for the C-118 Liftmaster which was lost in the Atlantic recently on a flight from Lakenheath, Suffolk, to the Azores.

Neptunes Replaced

IT is announced that most of the Neptunes now in service with R.A.F. Coastal Command are to be returned to the United States and replaced by Shackletons. Neptunes were first received in 1952 under the Military Defense Aid Program. The need to spend dollars when purchasing spares for these aircraft is quoted as a principal reason for this decision.

A few seconds after the Valiant's weapon exploded. The altitude of the air-burst has not been revealed, but this photograph suggests that it was fairly near the ground—perhaps at about the centre of the picture (above it is the mushroom cloud and below it, probably, dust sucked up from the ground). The criss-cross trails are from rockets fired beforehand to indicate the behaviour of the blast-wave.

Sea Venom Ejector Seats

EJECTOR seats are to be fitted to Sea Venoms in service with the Royal Australian Navy. A pair of Martin-Baker Mk 4 seats was shown installed in a Sea Venom at the S.B.A.C. display.

Luftwaffe Moves In

HANDING over of the R.A.F. station at Fassberg is almost complete. Recently the last Venom wing stationed there moved to another airfield, and the occasion was marked by a party at which one of the guests of honour was the station's new Commandant, Col. Ludwig-Hardeg. G/C. G. A. Brown, who commanded the R.A.F. at Fassberg, is now Officer Commanding R.A.F. Gutersloh. Transfer of the base will not be completed immediately as some R.A.F. administrative staff are remaining.

Senior Appointments

THE Air Ministry announces that A. Cdre. J. D. Baker-Carr, C.B.E., A.F.C., is to be Senior Technical Staff Officer at H.Q. Fighter Command, with the acting rank of air vice-marshal. A.V-M. Baker-Carr has specialized in air armament during his career and from 1948 to 1952 was Director of Armament Research Development (Air) at the Ministry of Supply. He then became Commandant of No. 4 School of Technical Training at R.A.F. St. Athan until taking up his present appointment.

A. Cdre M. E. M. Perkins has been appointed Commandant of No. 4 Technical Training School at St. Athan. He was a production overseer for the Ministry of Aircraft Production at aircraft factories during the war, and later undertook engineering duties in the Far East, commanding No. 309 Maintenance Unit in South East Asia. He served on an exchange posting to the United States and, until his present appointment, was Senior Technical Staff Officer at Fighter Command.

G/C. W. I. G. Kerby has been appointed Director of Personnel Services (Provost Marshal), with acting rank of air commodore, in place of A/Cdre. H. J. G. E. Proud, who is retiring. A/Cdre. Kerby has served with the R.A.F. since its formation and was the first provost officer to be commissioned in the 1920s. He has served on provost duties at home and abroad ever since and thus becomes the first officer of the provost branch to be appointed Provost Marshal of the R.A.F.

U.S. Medals of Freedom

TWO Royal Air Force officers, who four years ago saved the life of a U.S. airman, were recently decorated with the United States Medal of Freedom at the U.S. Air Attaché's office in London. They are F/O. J. W. Downs and F/O. D. C. Mills, who, while undergoing training in Canada, were flying on leave in an American C-119 which crashed and caught fire. Escaping unhurt themselves, they saw the aircraft blow up and found an airman with his clothing ablaze. Releasing their parachutes, they used them to extinguish the flames. The airman, though seriously injured, recovered.

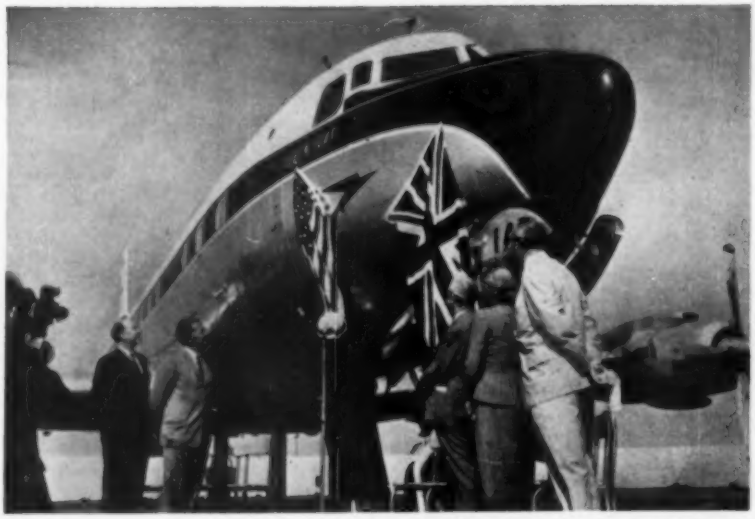
Squadron History

INFORMATION and photographs concerning the history of No. 9 Sqn. are being sought by F/O. G. Foster of No. 9 Sqn., R.A.F. Binbrook, Lincoln. Contributions will be carefully handled and returned if requested.

Reunion

THE ninth Reunion Dinner of No. 2 A.D.U. will be held at the R.A.F. Reserves Club, 14 South Street, Park Lane, London, W.1, on Saturday, November 24. Details from Humphrey Wynn, 4a Belsize Grove, London, N.W.3 (tel. Primrose 9428).

CIVIL AVIATION



The scene at Santa Monica as the first of B.O.A.C.'s ten DC-7Cs was handed over on October 15, two days ahead of schedule (see accompanying news item). Lord Rennell (fourth from right) accepted the aircraft from Mr. Donald W. Douglas, president and founder of Douglas.

DELIVERY THE DOUGLAS WAY

THE contract for ten DC-7Cs signed by Sir Miles Thomas, then B.O.A.C. chairman, on March 18, 1955 (nine months before the type flew), called for delivery of the first four aircraft by December 31 this year. The precise "delivery by the vendor" date for the first aircraft—October 17 this year—was notified a few months after the contract was signed. Last week, on October 15, the first aircraft G-AOIA was formally handed over to the Corporation by Mr. Donald Douglas Sr. at a small ceremony at Santa Monica (see accompanying picture), two days ahead of the schedule laid down more than a year ago. B.O.A.C. have now been promised seven, not four, aircraft by the end of this year.

As previously recorded in *Flight*, B.O.A.C.'s first DC-7C services are due to start on the North Atlantic in January. Crews are at the moment training at Santa Monica under Capt. M. J. R. Alderson (formerly Comet fleet manager). By April the service will be extended from New York to San Francisco, where it will link up with Qantas. Next summer, says B.O.A.C., the Corporation's Seven Seas schedules will be stepped up to more than one per day between New York and London; westbound services will for the first time be non-stop on most days of the year, cutting Stratocruiser flight-time in this direction by about four and a half hours.

SATISFIED CUSTOMER

SOME quoteworthy remarks about the Viscount and the Comet appeared in a paper read recently before the Institute of Aeronautical Sciences by Mr. J. B. Franklin, Capital Airlines vice-president of operations. The paper is reproduced in the October issue of *Shell Aviation News*.

"Only 19 per cent of our mechanical delays on the Viscount are attributable to power egg discrepancies," Mr. Franklin said, "compared to 57 per cent on our Constellations," and: "Our rate of unscheduled component changes on the Viscount, even at this stage . . . is hardly 60 per cent of that on tried and proven conventional aircraft. We believe that more than 90 per cent of our engines will reach full life expectancy compared to 30 per cent to 60 per cent expectancy on most piston engines."

Pilots changing over from piston engines to turboprops required no longer than from a DC-4 to a Constellation, Mr. Franklin said. The Viscount check-list was substantially shorter—there were only 84 items compared with the 104 on the Constellation and 92 on the DC-4. Turboprop simplicity had resulted in experience at Chicago of an average 45 seconds taxi-time from start-engines to take-off. To the ground personnel, engine cleanliness was one of the most striking maintenance characteristics. "It is quite something to look at a Dart engine with a thousand hours on it and find it as clean as when it was installed." In 120,000 engine-hours only one propeller had been feathered, and the cause had been eventually traced to a faulty oil pressure transmitter.

Mr. Franklin's views on Capital's Comet order, stated in his paper, nicely balanced Qantas' recent remarks about their choice of American jet transports. "The Comet," Mr. Franklin said, "like the Viscount, was an aircraft in being; one could see it, ride in it, fly in it . . . it has undergone the equivalent of 300,000 hours of structural testing. Furthermore it was powered by four Rolls-Royce Avon jet engines, again a proven design. . . . We will receive our Comets only two years from now, well ahead of other jets, and simultaneously with indicated deliveries of American manufactured turboprops. We at Capital are sold on turbine-powered transports . . . they do not present any insuperable operating or maintenance problems, they offer greater reliability, safety and economy and the travelling public demands them. What more cou'd you ask?"

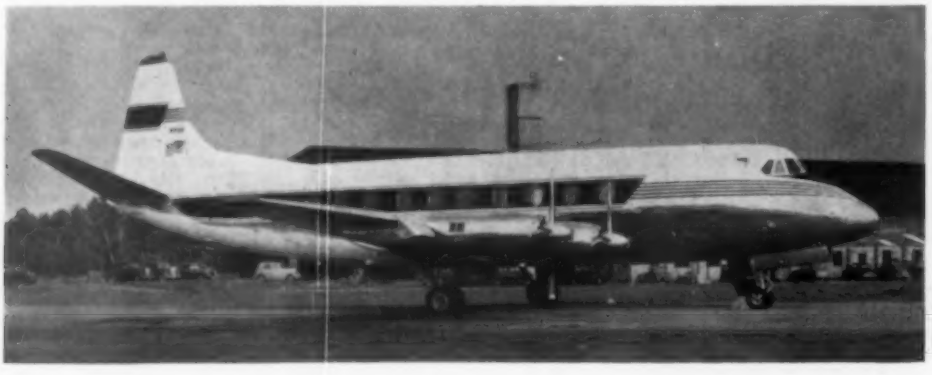
AIR TRANSPORT RESERVE

THE need for a military air transport service as part of an overall British air transport policy has again been advocated, this time by Air Chief Marshal Sir Gordon Pirie, chairman of the Air League of the British Empire. In a letter to *The Times* on October 17 he suggested that such a service should be supplemented by a well-equipped civil reserve with long-range transports. "No such reserve at present exists," he said.

In another letter, Mr. Eoin C. Mekie, chairman of British Aviation Services, said: "Recent events have shown that the independent air companies are on the basis of availability which . . . Sir Gordon Pirie rightly desires for the Air Transport Reserve." He said that, with an easing of restrictions and long-term trooping contracts, it was "well within the scope" of the independents to supply "the entire transport reserve the country needs."

BONN AIRPORT

SOMETHING of a clash has occurred over the future of Wahn, the West German airport near Bonn, which is a NATO master diversion airfield and is also in demand for civil traffic. It is already in use by Lufthansa, and K.L.M. and Swissair have signed



Seen here in the October sunshine at Hurn, having just emerged from the factory, is the first of three executive Viscounts for the U.S. Steel Corporation. The second aircraft is also completed, and the third is close behind. The aircraft are to have provision for nose-radar, air-steps, and long-range slipper and belly fuel tanks.

Discussing the Herald after an hour's flight is Mr. d'Erlanger of B.O.A.C. with (left) Mr. J. Allan, chief designer of Handley Page (Reading); G/C. Collard, H.P. sales manager; and Sir Frederick Handley Page. The flight was at Woodley on October 13.

agreements with the Federal Government for its use, but the number of civil aircraft which can be accepted is limited while the airfield is used by NATO. The West German Minister of Transport, Herr Seebohm, has decided that the Lufthansa service will have to be transferred to Dusseldorf—a further 25 miles away from Bonn—so that K.L.M. can use the airport.

Matters reached a head when Dr. Adenauer, waiting for M. Guy Mollet, the French Prime Minister, had to stand in the rain for 40 minutes while jets were landed by the R.A.F. flying control. After an apology by the British Ambassador a statement was issued saying that the question of the future of Wahn has been referred back to NATO.

SEVEN KEY MEN

THE most important outcome of the I.C.A.O. General Assembly at Caracas (*Flight*, July 20) was the decision to appoint a six-man task force under the chairmanship of I.C.A.O.'s president, Dr. Edward Warner, to determine the improvements needed to the world's air navigation facilities. The six members of this force have just been named. They include Sir Victor Tait, chairman of International Aeradio, until recently deputy chief executive of B.O.A.C.

The others are: Col. Luis de Azcarraga, Director-General of Flight Safety, Spain, and chairman of technical commission of the I.C.A.O. Assembly in 1953; Col. Helio Costa, Director-General of Airways, Brazil, and chairman of the third session of the I.C.A.O. communications division in 1949; A. P. Dekker, Deputy Director of Civil Aviation in the Netherlands, chairman of technical commission of the I.C.A.O. Assembly in 1950, and chairman of North Atlantic ocean stations conferences in 1953 and 1954; Jerome Lederer, managing director of the Flight Safety Foundation, U.S.A., and Director of the Daniel and Florence Guggenheim Aviation Safety Center; and René Lemaire, President of the Council on Auxiliary Services and Air Navigation, France, and formerly Secretary-General of French Civil Aviation.

If these men find cases where facilities—either for technical or financial reasons—cannot be provided by the nations concerned, they will discuss possible means of overcoming such difficulties with the governments concerned. The panel will then report its findings to the I.C.A.O. Council and will recommend ways in which the resources and procedures of the Organization can best be applied to remedy the shortcomings. Target-date for the completion of findings was set by the Caracas conference as the end of 1957.

DOVE SALES APPROACH 500

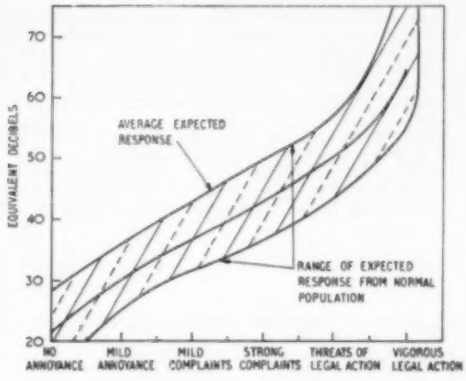
THE de Havilland Dove order-book rose to 486 (476 delivered) last week when six of the eight-seat Series 5 version were bought by the Iranian Oil Consortium. Delivery will begin in a few weeks' time. The Consortium, which is controlled by British, American, Dutch and French interests, is responsible for the operation and development of the South Iranian oil fields. The Doves will be operated on regular staff communication services between the Abadan refinery and the oil fields in the foothills of the Zagros Mountains, 40 minutes' flying time by Dove.

Dove population in the Middle East is already quite considerable: operators there include Gulf Aviation, Iraqi Airways, Iraq Petroleum, and the air forces of Lebanon, Jordan and Iraq.

This is the most sizeable civil purchase of "airliner" Doves for some time; most of the orders nowadays are for the executive version (about 80 have been sold into the U.S.A. alone.) With only 14 to go for its quincentenary, and outwardly little different from the aircraft of 12 years ago, the Dove looks good for many more orders yet.

WHAT NOISE ANNOYS . . . ?

WHATEVER the effects of high frequency noise upon an aircraft's structure (a digest of Capt. L. Arthur's study on this subject appeared in *Flight* last week), loud noises have an apparently predictable effect upon the human ear. This aspect of the noise problem is reviewed by a Freeman of the Guild of Air Pilots and Air Navigators, Mr. George R. Gibson, in the Guild's Journal for autumn 1956. We reproduce below a graph which Mr. Gibson has used to illustrate his article *Aerodynamic Noise—Cause and Effect*. The curve (compiled from U.S. Air Force statistics) shows the "probability of complaint" in a suburban community, based on such factors as type of noise, duration and frequency of occurrence, time of day, type of neighbourhood, previous noise exposure, and so on.

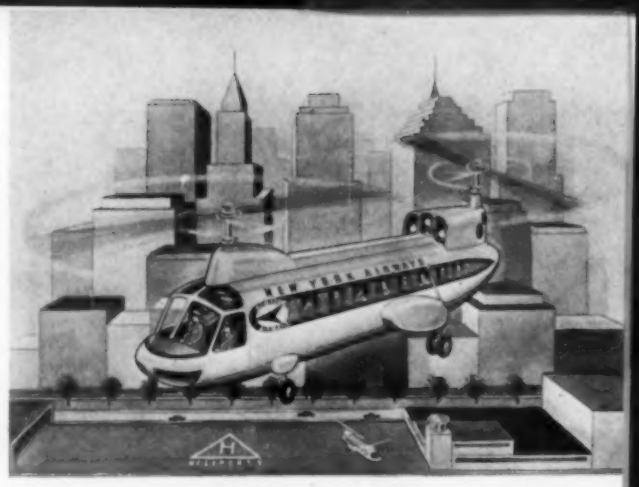


Gas turbine noise reaction—in units of unusual dimension.

As an example, the noise created by a jet engine of 5,000 lb static thrust being run continuously at 10,000ft from "a suburban community with little noise-exposure history" would evoke mild complaints at the most, but a 20,000 lb static thrust engine being run at the same distance would be well over the noise level ranking for "vigorous legal action." The "equivalent decibel level" of the scale is arbitrary and intermittent exposure of up to ten times an hour would reduce the equivalent noise level of the 5,000 lb thrust engine from 30 to about 23 decibels.

How can the noise nuisance be overcome? By segregation, insulation and absorption, suggests Mr. Gibson. Since segregation would entail airports situated remote from communities, insulation and absorption ideas have been developed; but however excellent (and expensive) the run-up pens and barriers are made, they cannot reduce noise at take-off or in the air. The real solution, the author concludes, is to eliminate the noise at its source. Reductions of up to 10 db have been effected by the use of corrugated nozzles, but only at the higher frequencies, and the sole solution existing at present appears to be the largely impractical one of segregation. At least the problem and the mechanics of noise are now better understood; further development must continue from there.

"I said now let's try it without the silencer."



An artist's impression of Bell's three-engined, 25-passenger turbine helicopter project, the D216. It will carry a maximum payload of between 6,000 lb and 8,000 lb at 120 m.p.h. An operating cost of 10 cents per seat mile is expected.

CIVIL AVIATION . . .

NORTHEAST AND THE BRITANNIA

A SPOKESMAN for Northeast Airlines, asked to comment on reports that the present investigation of the airline by the Civil Aeronautics Board might hold up the proposed Britannia purchase, said that they were "absolutely incorrect." There had been "no change" in the company's plans to purchase Britannias. The C.A.B. is investigating whether Howard Hughes has gained control of Northeast in addition to the control he already has of T.W.A.

DITCH WITHOUT A HITCH

A MESSAGE which reflects everyone's admiration for the "text-book ditching" of a PanAm Stratocruiser in the Pacific on October 16 has been sent to the C.A.A. by the Air League. The text of the cabled congratulations read:

"Chairman and Council of Air League of the British Empire, a body devoted to development commercial aviation, wish express their deep admiration of courage and high professional skill of captain of aircraft *Sovereign of Skies* and conduct of crew resulting in saving lives thirty-one passengers. This feat will rank high among great traditions of American merchant airmen. Request you convey this message Captain Ogg and crew of aircraft."

The Stratocruiser had left Honolulu on an overnight flight to San Francisco when first one and then the other of its outboard engines failed. The pilot, Captain Richard Ogg, decided that the risk of trying to return to Honolulu was too great, so he headed for the weather ship *Pontchartrain*. This he circled for three hours until dawn came, when he jettisoned fuel and, after two practice runs, made a successful touchdown on the sea. Passengers and crew of the Stratocruiser got out of the aircraft into its four life-rafts and were then taken on board the *Pontchartrain* by the weather ship's lifeboats.

BRISTOL'S NEW AIRPORT

OUR issue of July 6 recorded the return to Bristol municipal authorities of the airport at Whitchurch, which had been requisitioned for 17 years. The usefulness of the airport as a West Country terminal was expected to be short-lived, and a move has had to be made to Lulsgate Bottom, eight miles W.S.W. The new municipal airport is expected to be ready for opening on April 17 next year, despite building delays caused by bad weather. The use of Lulsgate as a diversionary alternate for London Airport is still under consideration.

BREVITIES

NEW ZEALAND National Airways Corporation may order ten Fokker Friendships to replace some of its 28 DC-3s, according to Mr. Shand, Minister of Civil Aviation.

* * *

The President of Vietnam has just taken delivery of an Aero Commander 560A.

* * *

The Boeing 707s ordered by Qantas will be in service in mid-1959 with "priority allocation" to the Pacific.

* * *

The American magazine *Flying* reports that a "major airline" is contemplating fitting JATO to its entire fleet of DC-7Bs.

* * *

K.L.M. and Roumania have reached basic agreement about a proposed air service between Amsterdam and Bucharest.

* * *

Five Convair 340s have been ordered by C.A.A. for use as radio and navaid calibration vehicles.

The chairman of Middle East Airlines, Sheik Najib Alamuddin, has been visiting London for consultation with Associated British Air Lines (Middle East), Ltd. He is seen here at London Airport with his wife.

Mr. Byron F. Sherrill has been appointed assistant to Mr. Warren Lee Pierson, chairman of T.W.A.

* * *

K.L.M.'s DC-7Cs will each be christened after a famous sea—e.g. White Sea, Red Sea, Mediterranean Sea, etc.

* * *

An average of 44,000 thunderstorms occur in the world every day, according to the Flight Safety Foundation.

* * *

A rain-repellant compound is reported to have proved more satisfactory than windscreen wipers on the the Boeing 707 during C.A.A. tests.

* * *

A Tu-104 arrived at Delhi on October 18 on its way to Rangoon. The flight was a proving operation for the forthcoming Olympic Games. A Tu-104 will fly the Russian team as far as Burma.

* * *

I.A.T.A. have moved their head office to more spacious quarters in University Street, Montreal. The new address is Terminal Centre Building, Montreal 3, Canada.

* * *

Sabena's profit in 1955 was the equivalent of £670,000. The annual report indicates that the airline carried 16,000 passengers on its helicopter services during the year.

* * *

There was a drop in air freight traffic at U.K. airports of 16 per cent during July in comparison with July 1955.

* * *

During the month of September a thousand tons of air freight, excluding vehicles, were flown across the English Channel by Silver City's Roadair service.

* * *

The United States federal airways system is valued by the C.A.A. at the equivalent of about £35m. Cost of operating, maintaining and amortizing is about £27m per year.

* * *

The Christopher Columbus Communications Prize (equivalent to about £3,000) has been awarded to I.C.A.O. The award is presented every four years by the City of Genoa, Columbus' birthplace.

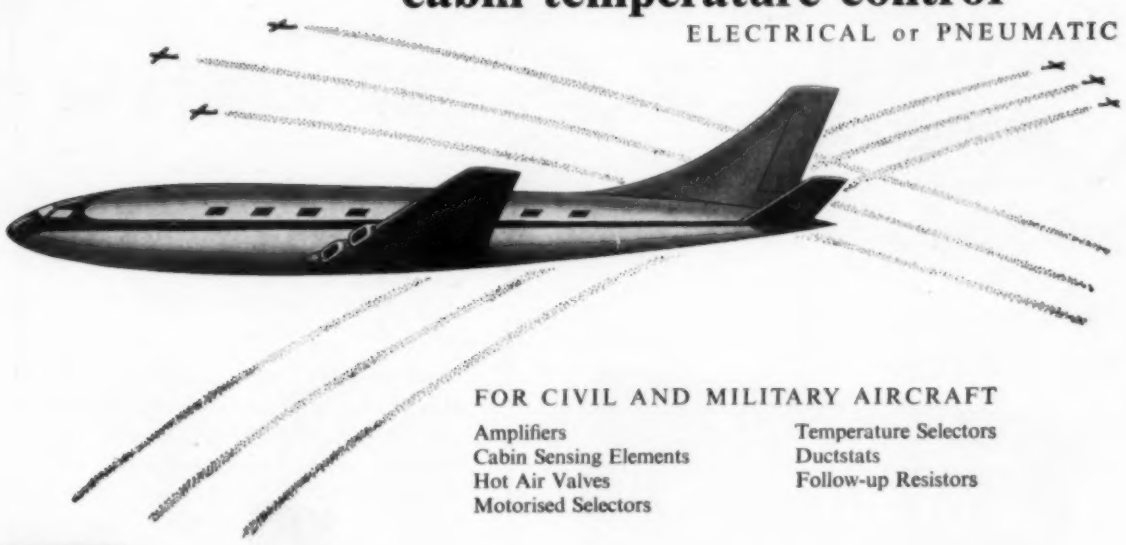
* * *

The latest count of total Viscount flying hours is 338,899. Highest utilization, which is being achieved by Butler, is 9 hr 8 min per aircraft per day. Capital comes second with eight hours. B.E.A., Aer Lingus and T.C.A. are just under eight hours.

TEDDINGTON

cabin temperature control

ELECTRICAL or PNEUMATIC



FOR CIVIL AND MILITARY AIRCRAFT

Amplifiers
Cabin Sensing Elements
Hot Air Valves
Motorised Selectors
Temperature Selectors
Ductstats
Follow-up Resistors

Teddington CONTROLS
REGD TRADE MARK

TEDDINGTON AIRCRAFT CONTROLS LTD., MERTHYR TYDFIL, SOUTH WALES. Telephone: Merthyr Tydfil 666
London Offices: 51 BROMPTON ROAD, S.W.3. Telephone: KENsington 4808.
COLNBROOK BY-PASS, WEST DRAYTON, MIDDLESEX. Telephone: Colnbrook 502.

Quality Products..

QUENCHING OILS

No. 2 Soluble Quenching Oil stands pre-eminent in providing uniform quenching speed and years of service throughout a wide temperature range.

It remains uniform with continued use and is good to the last drop.

No. 2 Soluble Quenching Oil outlasts other quenching oils and, based on ultimate cost, is the most economical to use.

We have a demonstration heat-treatment plant at our Birmingham works and our metallurgical staff will gladly advise on the selection and best application of our efficiency products.

Edgar Vaughan & Co. Ltd.

BIRMINGHAM · 4 · ENGLAND

Works and Depots at: Birmingham, Manchester, Liverpool, Southall (Middx.), Bristol, Glasgow

News for all photographers!

Amateur PHOTOGRAPHER

The journal for everybody with a camera

IN NEXT WEDNESDAY'S

Amateur PHOTOGRAPHER

★ PHOTOKINA REVIEWED
★ GUYS AND DOLLS
★ IN THE DANCE HALL
★ SHOOTING THE CHILDREN

Things move *fast* in the photographic world! New techniques, equipment and ideas appear daily, and A.P. is the journal that tells you all about them, solves your problems and shows you the world's finest camera studies. Our list of features is a glimpse of what awaits you in Wednesday's issue. Start reading A.P. now—it's the finest way to *better* photography!

From all newsagents • 1s. as usual.

HALF SIZE REPRODUCTION
of the
ENGINE NAMEPLATE
used on the
BRISTOL ORION
(BE.25)

Made in the works of

THE METAL GRAVURE CO. LIMITED

BABINGTON WORKS,
KNOLLYS ROAD, LONDON, S.W.16

Specialists in the manufacture of

NAMEPLATES AND DIALS FOR HIGH CLASS EQUIPMENT

Established over 50 years

there's never a drip through

a *genuine* *Jubilee* **clip**
REGD. TRADE MARK

L. ROBINSON & CO. (GILLINGHAM) LIMITED
London Chambers, Gillingham, Kent
Phone 5282

FLIGHT and AIRCRAFT ENGINEER

PRESS DAY—*Classified advertisement "copy" should reach Head Office by* FIRST POST THURSDAY *for publication in the following week's issue subject to space being available.*

CLASSIFIED ADVERTISEMENTS

Advertisement Rates. 5/- per line, minimum 10/-, average line contains 6-7 words. Special rates for Auctions, Contracts, Patents, Legal and Official Notices, Public Announcements, Public Appointments, Tenders 6/- per line, minimum 12/-. Each paragraph is charged separately, name and address must be counted. All advertisements must be strictly prepaid and should be addressed to FLIGHT Classified Advertisement Dept., Dorset House, Stamford Street, London, S.E.1.

Postal Orders and cheques sent in payment for advertisements should be made payable to Iliffe & Sons, Ltd., and crossed & Co.

Trade Advertisers who use these columns regularly are allowed a discount of 5% for 13, 10% for 26 and 15% for 52 consecutive insertion orders. Full particulars will be sent on application.

Box Numbers. For the convenience of private advertisers, Box Number facilities are available at an additional charge for 2 words plus 1/- extra to defray the cost of registration and postage, which must be added to the advertisement charge. Replies should be addressed to "Box 0000, c/o Flight," Dorset House, Stamford Street, London, S.E.1.

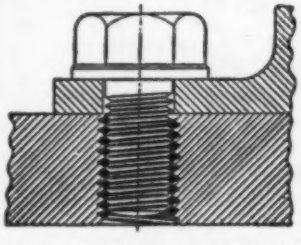
The Publishers retain the right to refuse or withdraw advertisements at their discretion and do not accept liability for delay in publication or for clerical or printer's errors although every care is taken to avoid mistakes.

Remember

POPPY DAY

BRITISH LEGION, HAIG'S FUND
PALL MALL, LONDON, S.W.1
(Registered under the War Charities Act 1940)

WIRE
THREAD INSERTS



FOR NEW DESIGNS AND SALVAGE

CROSS MFG. CO. (1938) LTD.
COMBE DOWN, BATH
TEL. COMBE DOWN 2355/6

AIRCRAFT FOR SALE

W. S. SHACKLETON LTD.

Europe's Leading Aircraft Brokers

offer

TWO VICKERS VIKINGS MARK IB

£25,000 each delivered U.K.!

RARELY do we have such an opportunity to offer two superbly maintained and equipped public transport aircraft at this price level. Only the introduction of Viscounts into their services has enabled C.A.A.C. to release these Vikings.
FULLEST details may be obtained from Aircraft Products (Pvt.) Limited, P.O. Box 1263, Salisbury, Southern Rhodesia, or,
W. S. SHACKLETON LTD., 175 Piccadilly, London, W.1. Cable: "Shackhud, London." Phone: HYDe Park 2448-9. [0070

R. K. DUNDAS

AEROPLANES BY DUNDAS

AVRO XIX, £750.
PROCTOR III. C. of A. £625.
PROCTOR V. Choice of two, from £700.
AUSTER V.B. Completely rebuilt. Good offer required.
AUSTER V. Rebuilt, starter, generator, wireless, long range tank.
AUSTER AUTOCAR. All extras, full radio. £2,350.

AEROPLANES BY DUNDAS

R. K. DUNDAS, LTD., 59 St. James's Street, London, S.W.1. Tel.: HYDe Park 3717. Cables: Dundas-Aero, Piccy, London. [0559

MITCHELL AIRCRAFT, LTD.

offer their services

in the supply of

AIRCRAFT.
ENGINES.
SPARES.
MITCHELL AIRCRAFT, LTD., Airport, Portsmouth.
TEL. 717641.
[0348

D. H. Moth Minor, 2 seater, enclosed cabin. C of A April 1957. £700 or near offer. Box 4845. [5847

VENDAIR of Croydon Airport offer:—Auster Autocrat, Auster Mk V, Proctors III and IV, Proctor V with long-range tanks, all in stock at Croydon Airport. Croydon 5777. [0603

ROLLASON AIRCRAFT AND ENGINES, LTD., Croydon Airport, The Tiger Moth Specialists. Rollason Aircraft and Engines, Ltd., Croydon Airport, have Tiger and Hornet Moths for sale. Immediate delivery. Hire Purchase terms. Telephone: CROydon 5151. [0130

AIRCRAFT ACCESSORIES AND ENGINES

ROLLASON'S for Tiger Moth and Gipsy Major, Gipsy Six and Gipsy Queen spares.
ROLLASON AIRCRAFT AND ENGINES, LTD., Phone CRO. 5151. [0131

IF your demand is for aircraft spares, engine spares, accessories or instruments, then your most likely and likeable—we hope—source of supply is:
A. J. WALTER, Gatwick Airport, Horley, Surrey. Tel.: Horley 1420 and 1510 (Ext. 1056). Cables: Cubeng, London. [0258

Solder with

LITESOLD
REGD. TRADE MARK

"PERMATIP"
AND
"PERMABIT"
INSTRUMENTS
FOR
GREATER SOLDERING EFFICIENCY

The soldering bit which maintains its face indefinitely without attention. 25 models available for mains or low voltage supply. Bit sizes 3/32 to 3/8 inch. Full details in booklet S.P.15 from sole manufacturers:—

LIGHT SOLDERING DEVELOPMENTS LTD
106 GEORGE STREET
CROYDON SURREY
Tel. CROydon 8589

DERBY AVIATION LTD.
Aircraft and Engine Overhaul
Sales — Service — Tuition
Scheduled and Charter Operators
DERBY AIRPORT
Telephone: ET WALL 323

We have just taken into stock an
AVRO 19 SERIES 2
with metal wings and Cheetah 15 engines.
This is available
FOR IMMEDIATE SALE
either at home or overseas.

☆ ☆ ☆ ☆

Equipped with comprehensive radio, luxury furnishings and all the requirements for executive travel, this aircraft may be inspected at any time at
— DERBY AIRPORT —

LONDON OFFICE: Telephone: ABBEY 2345
78, BUCKINGHAM GATE, S.W.1.

A HUNTING-CLAN COMPANY

FIELD'S

World Wide

PRATT & WHITNEY ENGINE OVERHAUL SERVICE

Sale · Exchange and Overhaul

CONTRACTORS TO
The Ministry of Supply and
United States Air Force

A.I.D. & A.R.B. Approved

Details on application to

FIELD AIRCRAFT SERVICES LTD.

72 WIGMORE STREET, LONDON, W.1.

Phone: WELbeck 7799
Cables: 'FIELDAIR,' WESDO, LONDON

A HUNTING-CLAN COMPANY

AIRCRAFT ACCESSORIES AND ENGINES

PHILLIPS & WHITE, Limited, offer from stock: Instruments and instrument parts. Navigational equipment, electrical components, airframe parts and hydraulic components and parts. Engine spares for de Havilland Gipsy Major and Queen series, also Armstrong Siddeley Cheetah IX, X and XV spares. Stock lists available.—61, Queen's Gardens, London, W.2. Tel.: Ambassador 8651, 2764. Cables: Gyrair, London. [0466

AIRCRAFT DELIVERIES

ALL makes of aircraft collected and flight delivered any part of the world. Fully insured in transit. Quotations by return. Brailsford, 2 Upper Tooting Park Mansions, Marius Road, Balham, S.W.17. Tel.: Balham 0402. [5746

AIRCRAFT SERVICING

REPAIRS and C. of A. overhaul for all types of aircraft.—Brooklands Aviation, Ltd., Civil Repair Services, Sywell Aerodrome, Northampton. Tel.: Moulton 3218. [0307

AIRCRAFT PROCUREMENT

GROUP CAPTAIN EDWARD MOLE, B.Sc., A.F.R.Ae.S., Aviation Consultant. Specialist service in the supply or disposal of all types of aircraft and aviation equipment. Quotations obtained upon request. —8, Brendon Street, London, W.1. PADdington 5406. [0403

CAPACITY AVAILABLE

KELLERING and profile milling in all metals. Send us your die blocks to copy from wood or plaster masters. Up to 5ft by 8ft max. size. We are die copiers to the izade.
ARMYTAGE BROS. (KNOTTINGLEY), LTD., The Foundry, Knottingley, Yorkshire. Tel.: Knottingley 2046. [0975

CLOTHING

R.A.F. officers' uniforms purchased; good selection of R.A.F. officers' kits for sale, new and reconditioned.—Fishers, Service Outfitters, 86-88 Wellington Street, Woolwich. Tel.: Woolwich 1055. [0567

CLUBS

HERTS. AND ESSEX AERO CLUB, Stapleford Tawney Aerodrome. M.C.A. approved private pilots' licence course. Auster, Gemini, Tiger, Hornet and Proctor aircraft. Trial lesson 35s. 15 miles centre of London. Central Line Underground to Theydon Bois, bus 250 to club. Open every day.—Tel.: Stapleford 210. [0320

CONTACT LENSES

MODERN CONTACT LENSES CENTRE 7(D.1), Endsleigh Court, W.C.1. Deferred Terms. Booklet sent. [0342

ELECTROPLATING

HEADLAMP reflectors heavily electroplated 100% silver, guaranteed, 6/- each, mirror finish. Post and packing 1/3 each. Cork seals 6d. each. Re-posted day received.—Send with P.O. to R. E. Packer, 169, Hotwell Road, Bristol, 8. [0980

Machinists of plastics for the Aircraft Industry
A.I.D. & A.R.B. APPROVED
Fairleads, Cleats, Panels, Knobs, etc.
E. S. ASTON & CO. LTD.
4 SEBASTIAN STREET,
CLERKENWELL, LONDON, E.C.1
Telephone: CLERKENWELL 2179

FLYING BOOTS

Lined throughout with soft luxurious Sheepskin, these excellent boots have all leather uppers, leather sole, rubber heel, strap and buckle adjustment and exclusive calf retaining strap **£5-9-6**

Sizes, Ladies 5-9 Gents 5-12

Terms to Flying Clubs. Trade Supplied. Send 4d. in stamps for illustrated catalogue.

Lewis

(Dept. F.) 124 Gt. Portland Street, London, W.1.
Tel. Museum 4314. Grams: Aviakit, Wesdo, London.

A.R.B. APPROVED

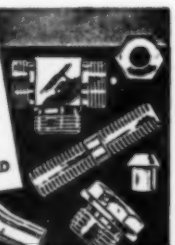
B. S. T. AERONAUTICAL CO., LTD.

C47 - DC3 Specialists

1. Starters, Generators, Tacho-Generators
2. Hydraulic, Vacuum, Fuel Pumps
3. Undercarriage Bolts and Bushes
4. Flight and Engine Instruments
5. A.N. Materials
6. Wheel and Brake Spares
7. Anti-drag Rings and Spares

BLACKBUSHE AIRPORT, CAMBERLEY
SURREY
TELEPHONE CAMBERLEY (CAM) EXT. 11 & 111

A.G.S. A.S. B.S.
STANDARD AIRCRAFT PARTS
A.I.D. & A.R.B. APPROVED



CURD COMPONENTS LTD
41, LONSDALE ROAD, W.11—*Bayswater 0319*

HELICOPTER SERVICES LIMITED
96, PICCADILLY, LONDON
Gro. 5495/6.
Offer their aircraft for all Helicopter services.

HELICOPTERS

HELICOPTER Charter. Machines available U.K. and overseas. Autair, Ltd., 76 Wigmore Street, London, W.1. Telephone: Welbeck 1131. [5606

MISCELLANEOUS

RETRACTABLE ball point pens $13.50 gr., balloons 75 cents gr. up. Pocket combs 79 cents gr., hunting knives $5.25 dz., 3in. steel scissors $3.50 gr., lipstick $4.50 gr., pocket knives $50 gr., 7in. pencils $1.60 gr., ball pens 4 cents each, teaspoons $2.25 gr. up. Dolls $4.50 gr., nylon tooth brushes $3.50 gr. up. Cloth-hair-shoe brushes 10 cents each, clocks, watches. Men's ties 15 cents each. Needles, safety-pins, costume jewellery, etc. 6,000 closeouts 50 per cent below price. Toys, dolls, pearl necklaces 7 cents ea. Razor blades $.50 per 1,000. Wallets 7 cents ea., compacts $4.50 doz up. Perfumes, belts, scissors, etc. Also agents wanted. PAUL COHEN, CO., Inc., 881 B'way, NYC3. [0295

MY FIFTY YEARS IN
FLYING
by HARRY HARPER
The World's First Air Correspondent
A vivid story by an eye-witness who has been able to watch the unfolding of an amazing half-century in the air. Ready on October 30th. from booksellers everywhere. 256 pages **12/6**
30 PAGES OF FASCINATING PHOTOGRAPHS FROM HARRY HARPER'S OWN COLLECTION.
A "DAILY MAIL" PUBLICATION

AERONAUTICAL TRADES AND MFG. CO. LTD.
219 Camberwell New Road, London S.E.5.
Standard Parts (B.S.S., A.G.S., S.B.A.C.)
Radio and Electrical Spares
A.R.B. Approved Stockists. Overseas Enquiries Invited.
Tel: Reliance 5437. Cables: Aertradman, London

AIRCRAFT PARTS WANTED
AMERICAN MANUFACTURE
Send us your lists. Cash.
State price, quantity and condition.
If possible, Manufacturer.
COLLINS SUPPLY COMPANY
9050 Washington Blvd., Culver City, Calif.

BKS
£500,000 of Viking Spares Actually in Stock

R.A.F. OFFICERS UNIFORMS
LARGE SELECTION IN STOCK
NEW AND RECONDITIONED
FISHERS, 86/88 WELLINGTON ST. WOOLWICH, S.E.18 'PHONE 1055

PACKING AND SHIPPING

R. and J. Park Ltd., 143/9 Fenchurch St., E.C. Tel.: Mansion House 3083. Official packers and shippers to the aircraft industry. [0012

PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned application to operate a scheduled air service:—

APPLICATION No. 979. From Starways Ltd., of Liverpool Airport, Liverpool 19, for a U.K. Internal Service with Dakota aircraft for the carriage of passengers, and supplementary freight between Liverpool (Speke) and Glasgow (Renfrew) at a frequency of from one to 14 services per fortnight for a period of seven years commencing January 1957.

THIS application will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to this application must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3, Dean's Yard, London, S.W.1 from whom further details of the application may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [5844

PUBLIC APPOINTMENTS

FEDERATION OF NIGERIA

Executive Officers, Grade I

Department of Civil Aviation

QUALIFICATIONS: Good education, energy and initiative. Previous administrative aeronautical experience either in Her Majesty's Forces or commercial aviation essential. Membership of Royal Aeronautical Society an advantage.

AGE LIMITS: Not more than 40 years.

DUTIES: Responsibility for dealing with varied aspects of civil aviation administration including staff matters, accounting, licensing, equipment and general office routine either at Departmental Headquarters or at Kano or Lagos Airports.

TERMS of appointment: On (1) permanent and pensionable or (2) contract/gratuity terms with emoluments in the scale (1) £720-£1,212 p.a. and (2) £774-£1,344 p.a. and gratuity on satisfactory completion of contract. (1) and (2) outfit allowance. Free passages officer and wife. Allowances and passage concessions for children. Furnished quarters at rental. Free medical attention. Generous leave. Income tax at local rates.

APPLY to Director of Recruitment, Colonial Office, London. S.W.1. State age, qualifications and experience. Quote BCD.98/14/011. [5838

TUITION

AIR SERVICE TRAINING

The only fully equipped private School of Aviation Specialist staff, comprehensive equipment and full residential and recreational facilities within the School ensures the soundest training for an aviation career.

M.T.C.A. APPROVED COURSES

for private and commercial pilots' licences and maintenance engineers' licences in categories "A" and "C."

HELICOPTER COURSES

for private and professional licences. Details available from the Commandant.

AIR SERVICE TRAINING, LTD.,

Hamble, Southampton. Tel. Hamble 3001/9. [0970

SURREY Flying Club, Croydon Airport, M.C.A. approved for private pilots' licences. Open seven days a week. Croydon 7744. [0293

A SUCCESSFUL career for your son. Aeronautical Technical and practical training for all branches of aeronautical engineering. Diploma course leads to executive appointments in civil aviation design and development, draughtsmanship, maintenance, etc. Extended courses to prepare for A.F.R.Ae.S. and A.M.I.Mech.E. examinations. Write for prospectus to Engineer in Charge, College of Aeronautical Engineering, Chelsea, London, S.W.3. FLAxman 0021. [0019

TUITION

CIVIL PILOT/NAVIGATOR LICENCES

AVIGATION, LTD., provides full-time or intermittent instruction and postal tuition, or a combination of any of these methods to suit individual requirements for the above licences. Classroom instruction can be provided for A.R.B. General, certain Specific Types and Perfomance Schedule examinations. Link Training Dept. at MONarch 1364.

FOR full details apply to The Principal,

AVIGATION, LIMITED

30 Central Chambers, Ealing B'way, London, W.5. Tel. Ealing 8949. [0248

FREE: Brochure giving details of courses in all branches aero eng., covering A.F.R.Ae.S., M.C.A. exams, etc. Also courses for all other branches of engineering.—Write: E.M.I. Institutes, Dept. F.26, London, W. (Associated with H.M.V.) [0964

Experienced
ELECTRONIC ENGINEER
for Aircraft Radar, Radio Systems and equipment, English, American installations into aircraft; must be able to instruct operators.
Senior appointment.
Rural, 30 miles London.
Immediate Hostel accommodation; assistance to obtain rented house after probationary period.
•
AVIATION TRADERS ENGINEERING LTD.
Stansted Airport,
Stansted - Essex

AIRCRAFT JACKS
WING AND PILLAR
All types available
Prices on application
Aero Maintenance Equipment Ltd.
100a Clapham Park Road, London, S.W.4
Telephone: MACaulay 2477/8

AIRCRAFT SPRING WASHERS

TO B.S. SPECIFICATION S.P. 47
CROSS MFG. CO. (1938) LTD., COMBE DOWN, BATH

BROOKLANDS AVIATION LTD.

NORTHAMPTON

require

SENIOR INSPECTORS

for work on

VALETTA and VARSITY AIRCRAFT

Regular Work and Overtime

APPLY TO:

BROOKLANDS AVIATION LTD.
Buttocks Booth, Moulton, Northampton

AN

INSTRUCTOR

for the firm's technical school is required by a well-known aircraft manufacturing Company.

A good knowledge of, and experience in, radar and electronics generally, and the ability to impart that knowledge to others, is essential.

Excellent surroundings and amenities are provided, and the position is permanent, pensionable and well paid. Your enquiries are invited, addressed in the first instance to the

Personnel Manager,
SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.,
Baginton, near Coventry.

SAUNDERS-ROE LTD.

require

SENIOR AERODYNAMICISTS
STRESS ENGINEERS
DRAUGHTSMEN

and other Technicians at their London and Osborne, I.o.W. design offices.

Qualified design engineers—resourceful men of original thinking and mature engineering judgement—who can meet the challenge of new problems, owe it to themselves to investigate the career opportunities now available in our organisation.

We can offer pleasant working conditions, salaries commensurate with ability, and assistance with accommodation for candidates selected to work at Osborne.

★ **Those interested should apply, quoting age, experience, qualifications and ref F/10 to the Personnel Officer, Saunders-Roe Ltd., East Cowes, I.o.W.**

MECHANICAL ENGINEERS

Armstrong Siddeley Motors Limited

have a vacancy in each of their Balancing, Bearings and Full Scale Structure Testing Departments. Also two vacancies in each of their Engine Accessories Test and Spinning Test Rig Departments.

Each of these positions requires initiative, provides first-class experience and offers prospects. Applicants will require to possess a degree or Higher National Certificate in Mechanical Engineering. Previous experience, though not necessary, will be an asset. Interviews will be conducted by the Chief Engineer or his Deputy. If desired, personal and domestic circumstances will be fully considered.

Applications, quoting M.E.D. to the **Technical Personnel Manager, Armstrong Siddeley Motors Ltd., Coventry.**

CHIEF INSPECTOR (AIRCRAFT)

FERRANTI LIMITED, EDINBURGH

require a

CHIEF INSPECTOR

for their Flying Unit. Applicants should have experience on Piston and Turbine powered aircraft, installation work for the flight testing of equipment and routine servicing of airframes and engines to A.I.D. and A.R.B. requirements. They should be holders of category "B" Licence for A/F type in Group 5-4 or Group 5-5, or have equivalent of experience in civil overhaul and repair work. Pensionable staff position and the salary paid will be appropriate to the responsibility involved. Please apply, giving full details, to the

Personnel Officer, Ferranti Limited, Ferry Road, Edinburgh, 5, quoting Ref. CI/TID./29.

PILOTS

BRITISH EUROPEAN AIRWAYS

have vacancies for

(a) **Pilots, 27 and under,** with Commercial Pilot's Licence and Instrument Rating. Salary £1,075-£1,195 per annum, depending on qualifications and experience.

(b) **Pilots under 25,** well advanced in studies towards, and with the qualifying flying hours for, the Commercial Pilot's Licence and Instrument Rating. Salary whilst unlicensed between £500-£700.

Full salary range for Pilots according to Rank, up to £2,900 p.a. Comprehensive Pension Scheme.

Apply in writing (quote ref. P.7) to **Senior Personnel Officer, Flight Operations, B.E.A., Keyline House, Ruislip, Middlesex.**

AT

'ENGLISH ELECTRIC', LUTON

Interesting and well paid vacancies exist for keen **DESIGNERS** and **DRAUGHTSMEN,** both **SENIOR** and **JUNIOR,** wishing to join a design team already firmly established in the **GUIDED WEAPONS** industry.

The work covers a wide range, including design and layout of:

small electronic units
electronic circuitry
hydraulic systems and small turbo power units
fine electro-mechanical devices
heavy precision test equipment

Qualifications to Degree or H.N.C. standard essential for the senior positions, and at least O.N.C. desirable in other cases.

Those interested are asked to send brief details to **Dept. C.P.S., 336/7 Strand, W.C.2, quoting Ref. F 699C.**

A NEW PROJECT!

NEW METHODS! NEW MATERIALS!

All waiting for

PLANNING ENGINEERS

BRISTOL AIRCRAFT LIMITED need planning engineers for an advanced and highly interesting project. The men they need would certainly have an ONC—probably an HNC—and considerable planning experience on either aircraft structures or machining. They would most probably have served an apprenticeship in the aircraft industry.

This is a really important job. And it's an interesting job too! If you think you can do it, write, with full details of education, qualifications, experience, to:

MR P A TOBIN, Room AIR/69/JF
BRISTOL AIRCRAFT
FILTON HOUSE, BRISTOL

BRISTOL

BRISTOL AIRCRAFT LIMITED

TUITION

SOUTHEND-ON-SEA Municipal Air Centre and Flying School. Comprehensive flying training for all pilots' licences, ratings and endorsements. Special facilities for instruments, night-flying and commercial pilot licences. No entrance fee or subscriptions. MUNICIPAL Airport, Southend-on-Sea, Essex. Rochford 56204. [0453

LEARN to fly, £26; Instructor's Licences and Instrument flying for £3 5s. per hour. Night flying £4 5s. per hour. Residence 6 guineas weekly. Approved M.C.A. Private Pilots' Licence course. Specialized course for Junior Commercial Pilot's Licence.—Wiltshire School of Flying, Ltd., Thruxton Aerodrome (Andover Junction 1 hour 15 minutes from Waterloo), Hants. [0253

TUITION

A.F.R.Ae.S., A.R.B. Certs., A.M.I.Mech.E., etc., on "no pass, no fee" terms. Over 95 per cent. successes. For details of exams and courses in all branches of aeronautical work, navigation, mechanical eng., etc., write for 144-page handbook free.—B.I.E.T. (Dept. 702), 10 Wright's Lane, London, W.8. [0707

SITUATIONS VACANT

SENIOR jig and tool Draughtsmen required. Aircraft tooling experience preferred, but not essential. Apply in writing, with details of experience, to F. G. Miles, Limited, Shoreham Airport, Sussex. [5836

MARSHALL

AIRPORT WORKS CAMBRIDGE

SENIOR AIRFRAME INSPECTORS
ELECTRICAL INSPECTORS

Must have recent experience on Multi-jet and Turboprop Aircraft
REPAIR, TRIAL INSTALLATION AND CONVERSION

Suitably qualified applicants will be given
Staff Rates and Conditions, including Contributory Superannuation, plus Housing Assistance if required.

Also

AIRFRAME FITTERS, AERO-ELECTRICIANS, SHEET METAL WORKERS
(on Stressed Skin repairs)

for interesting long-term programme, Development, Trial Installation and Modification.

Good rates of pay under regular review, upgrading governed by merit and recommendation. Overtime and Incentive Bonus. Single Lodgings on Housing Estate near Works.

Write, call or phone for interview: Cambridge 56291, *Ext.* 36
EMPLOYMENT OFFICER

GLOSTER AIRCRAFT CO. LTD.,

GLOUCESTER

have vacancies for

AIRCRAFT ELECTRICAL DRAUGHTSMEN

AIRCRAFT EXPERIENCE DESIRABLE BUT NOT ESSENTIAL

The factory is ideally situated in the Cotswolds. Pension Scheme. Good canteen, sports and welfare facilities. Single accommodation available in Residential Club.

Applications, stating age, previous experience and employers should be addressed to the

CHIEF DESIGNER

SITUATIONS VACANT

HUNTING PERCIVAL AIRCRAFT, LTD.

require several

SENIOR DRAUGHTSMEN

to undertake aircraft standardization work, in their Main Design Office at Luton, Beds. In addition to their Drawing Office experience, it is desirable that candidates should have knowledge of modern production methods.

EXCELLENT working conditions in modern new offices.

PENSION and Life Assurance Scheme in operation.

APPLICATIONS, giving full details of qualifications, experience, age and salary required, and quoting Ref. MF/ST/6, should be addressed to the Personnel Manager, Hunting Percival Aircraft Ltd., Luton Airport, Beds. [5829

B.O.A.C.

offers Ideal Careers

FOR PILOTS

ESSENTIAL minimum qualification 25 years of age or under, with at least 150 hours flying as pilot in charge on any type. (Pilots with commercial licence and instrument rating considered up to 27.) Salaries, when qualified, from £1,000 to £3,430 per annum. Pension Scheme. No fixed retirement age from flying. Pilots of good education, having 150 hours solo flying experience, should write Chief Personnel Officer, B.O.A.C., London Airport, sending stamped addressed envelope for application form. [5799

METROLOGIST

required for

the inspection of Wind Tunnel Models

MUST be good Mathematician and used to complicated checking procedures.

AFTER satisfactory probationary period housing accommodation may be recommended.

WRITE giving full particulars to Personnel Department, Vickers-Armstrongs (Aircraft), Limited, South Marston Works, nr. Swindon, Wilts. [5839

SKYWAYS LIMITED

require

FIRST Officers. Applicants must be in possession of at least a commercial pilot's licence with instrument rating and preferably have had experience on modern 4-engined aircraft. Salary in scale £1,205 to £1,475 per annum.

SECOND Officers. Applicants must hold commercial licence preferably with instrument ratings and should have had at least 500 flying hours' experience. Salary in scale £875 to £995 per annum. Good conditions of service, pension scheme.—Apply Personnel Manager, Skyways, Ltd., Stansted Airport, Essex. [5842

BRITAIN'S LARGEST INDEPENDENT OPERATOR

has the following vacancies at Stansted Airport:—

1. Draughtsmen of intermediate standard; preferably with experience in the aircraft industry.
2. Airframe fitters; must be experienced on modern four-engined aircraft preferably Hermes or Yorks.
3. Sheet metal workers; must be skilled and should preferably have had experience on aircraft repair work.

EXCELLENT rate of pay and conditions of service. Hostel accommodation available. Apply Personnel Manager, Skyways Ltd., Stansted Airport, Essex. [5841

AIRCRAFT ENGINEERS

Top Rates

1. Airframe Fitters, skilled. Experience on Vikings, Dakotas, Bristol Freighters, preferably.
2. Hydraulic Fitters, skilled.
3. Sheet Metal Workers, skilled.

APPLY: Personnel Officer, Personnel Department, **Eagle Aircraft Services Limited,** Blackbushe Airport, Camberley, Surrey. Phone: Yateley 2371. [5843

AIRCRAFT ENGINEERS

LICENSED "A" and "C" Engineers and Maintenance Fitters required for Helicopter Operations Overseas. Preference will be given to those with Helicopter experience; but this is not essential. Attractive terms include good salary, living allowance and two months paid holiday each year. Applications with full details to Fison-Airwork Ltd., Bourn, Cambridge. [5846

AERIAL SURVEY
AND
MAPPING PERSONNEL
IN THE
UNITED STATES

Employment and top wages available to men with experience in the following fields:

STEREO OPERATORS—experience in the operation of Multiplex, Kelsh Plotter, Wild A-7, and Zeiss C-8 Stereoplanigraph.

AERIAL MAPPING PILOTS—Must have at least 1,500 hours logged solo time including at least 300 multiple engine time and 200 hours of successful precision aerial mapping work.

AERIAL PHOTOGRAPHER—Must be experienced in precision aerial photography.

Permanent employment with rapidly expanding 25-year oil company located in San Antonio, Texas, U.S.A., 40-hour week, sick leave, vacation leave, group life and hospitalization insurance and other benefits.

Suitable applicants interviewed in London

Apply Box No. 340,
Aldridge Advertising,
1, Whitefriars St., London, E.C.4.

TRANSAIR

Vacancies occur for

CAPTAINS
FIRST OFFICERS
and
RADIO OFFICERS

Applications are invited from personnel with the following qualifications:

Captains—A.L.T.P.

First Officers—Commercial Licence and Instrument Rating

Radio Officers—First Class Flight Radiotelegraphy Licence

Apply to:

Operations Manager, Transair Ltd., Croydon Airport, Surrey.

MARSHALL
AIRPORT WORKS CAMBRIDGE

require

AERO ELECTRICIANS

for work on Multi-jet and Turbo-prop Aircraft.

Bench work and testing.

Overtime and Production Bonus.

Single lodging accommodation available near Works.

Write, call or phone:
Cambridge 56291, Ext. 36.
EMPLOYMENT OFFICER

SENIOR ENGINE DESIGNER

A position is being created in our Engine Division for a Senior Designer to act as Assistant to the Chief Designer. Technical education to degree standard and a minimum of five years' experience in gas turbine design are essential qualifications.

Applications in writing, giving details of qualifications and experience, should be sent to:

The Chief Designer,
Engine Division,
BLACKBURN & GENERAL AIRCRAFT LTD.,
Brough, E. Yorkshire.

EDGAR PERCIVAL AIRCRAFT LTD.

STAPLEFORD AERODROME, ROMFORD, ESSEX
(Theydon Bois 2321)

We have vacancies for the following staff:—

Senior and intermediate Stressmen
Senior and intermediate Draughtsmen
Technical Author and Artist

Reply to the Chief Designer at earliest opportunity.

D. NAPIER & SON, LTD.
LUTON AIRPORT, BEDS.

There are vacancies in the above expanding organisation working on propeller turbines, rocket motors and ramjets, "Spraymat" de-icing, and a variety of new projects.

TECHNICAL ASSISTANTS (SENIOR) for work on problems of aero-dynamics, heat transfer, duct and nozzle design, flight analysis and prediction. Degree or H.N.C. standard.

SENIOR AIRCRAFT ESTIMATOR for production of estimates on prototype aircraft projects.

SENIOR TECHNICAL AUTHOR for publications of all types.

TECHNICAL AUTHOR for "Spraymat" de-icing manuals.

ENGINEERS for "Spraymat" de-icing in manufacturing group with experience in processes involving synthetic resins, or design and development experience on special purpose machine tools. Also Planning Engineer to control work loading in Experimental Workshop, workshop cost control and estimating experience an advantage.

WEIGHT CONTROL ENGINEER with D.O. experience of approx. O.N.C. standard.

SENIOR DESIGNER for project work on Rocket Motors.

DRAUGHTSMEN. Design and detail covering wide fields of work in the above classes.

Applications, in writing, with full particulars, initially to Dept. C.P.S., 336/7 Strand, W.C.2, quoting reference F816A.

THE ENGLISH ELECTRIC CO. LTD.
AIRCRAFT DIVISION—COMPUTING SECTION

GRADUATE MATHEMATICIANS OR PHYSICISTS are required for a number of vacancies in connection with programming work on DIGITAL COMPUTERS. The Division will have its own computer in the near future and interesting and progressive careers are offered to men and women wishing to take up this new field of work, which will cover all department's activities.

Men with Higher National Certificate or suitable experience are also required for work on the maintenance and development of the DEUCE digital computer and will be given suitable periods of training in the Company's computer works at Kidsgrove before joining the Aircraft Division at Warton in Lancashire.

Apply in the first instance, giving full particulars, to
DEPT. C.P.S., 336/7, STRAND, W.C.2, QUOTING REF. F 1713A.

GLOSTER AIRCRAFT CO. LTD.,
GLOUCESTER,

requires

TWO TECHNICAL ASSISTANTS

aged between 27 and 30 years

with some years experience in flight test reduction.

Candidates must be able to write concise reports on completed tests and will be expected to prepare programmes on aircraft under their control.

Applications should be made to the

PERSONNEL MANAGER

SITUATIONS VACANT

SKYWAYS LIMITED

require

RADIO OFFICERS

APPLICANTS must be in possession of M.T.C.A. 1st class flight radio operator's licence. Salary in scale. £885-£1,340 per annum. Pension scheme. Apply Personnel Manager, Skyways Ltd., Stansted Airport, Essex. [5792

BUYER. Experienced man for substantial aircraft company London area. Good conditions. Reply full details age, exp., salary reqd. Box 4837 [5845

DRAUGHTSWOMAN required by Aircraft Equipment Company in South Bucks. Salary according to age and experience, up to £13 per week. Apply to Box No. 1775. [0475

AIRCRAFT section leader design draughtsman required. Salary according to age, experience and qualifications up to £900 per annum. Pension scheme/superannuation fund in operation. Write or phone: BAYNES AIRCRAFT INTERIORS LIMITED, Langley Aerodrome, Bucks. Telephone: Langley 451. [0476

TEST and Laboratory Engineers required for gyro and electro mechanical instruments. Apply stating age, experience and salary required to S. G. Brown, Ltd., Shakespeare Street, Watford, Herts. [0147

ARMSTRONG SIDDELEY MOTORS LIMITED, will offer a position to a Mechanical Engineer who has experience on engine starting systems. Applicants must have at least a Higher National Certificate and preferably a degree.

THE position is assured and will open up good prospects.

IF desired personal and domestic conditions will be fully considered.

Interviews will be conducted by the Chief Engineer or his deputy.

SALARY will be in the range of £15/£17 per week, depending on experience and qualifications.

Applications, quoting ESS/CG, to the Technical Personnel Manager, Armstrong Siddeley Motors, Limited, Coventry. [5785

A PRODUCTION Control Engineer is required to control the production of a small organization undertaking extensive overhaul work on various aircraft ancillaries in Hertfordshire. This is a superannuated position offering scope to the right man. Please write to Box No. 4651 stating present salary and giving details of experience and qualifications. [5814

Aircraft Engineering Opportunities

AVRO's varied and advanced design projects offer Technicians and Engineers unlimited opportunities in the fields of aircraft design, aerodynamics, propulsion, structural design, engineering development, electronics and radar. Never before has there been such a challenge to the imagination of the individual. AVRO's pride in the past and present achievements is minimised only by the anticipation and enthusiasm it has for the future.

Vacancies for the following personnel are available in the various departments of the Organisation at Manchester and Woodford, Cheshire, and also in the new West London Design Group.—

Aerodynamicists
Design Technicians
Structural Engineers
Stressmen
Flutter Technicians
Instrument Draughtsmen
Aircraft Draughtsmen
Mechanical Draughtsmen
Electrical Draughtsmen
Structural Draughtsmen
Mathematicians
Control System Engineers
Flight Test Engineers
Mechanical Engineers
Wind Tunnel Technicians
Trials Engineers
Electrical Engineers
Internal Flow Engineers
Technical Assistants
Technical Authors
Technical Artists

In most cases there are junior and senior appointments available, and aircraft experience is not essential.

Successful applicants will find the salaries, opportunities and working conditions are exceptional, and there is an attractive Pension and Assurance Scheme available.

If you think you can fill one of these positions, or if you are interested in entering the AVRO Design, Development or Research groups, please write to:—

PERSONNEL MANAGER
A. V. ROE & COMPANY LIMITED
GREENGATE, MIDDLETON, MANCHESTER

giving particulars of your age, qualifications and experience. All inquiries will be treated in strict confidence.

A. V. ROE & CO., LIMITED,—MANCHESTER

SITUATIONS VACANT

WANTED immediately, Senior and Intermediate Draughtsmen for work on an interesting Aircraft programme. Good salaries and conditions. Apply in writing with details of previous experience to: King Aircraft Corporation, Hillington, Glasgow, S.W.2. [0423

AIRCRAFT Engineer, A. and C. licences covering light types, required to maintain small fleet including Chipmunks. Long hours and hard work, but scope for initiative and good pay. Southern England. Vacancy also for enthusiastic young lad to learn trade. Box 4662. [5816

FIELD AIRCRAFT SERVICES, Bovingdon Airport, require staff experienced in the overhaul and test of Gyro instruments and also electrical components. Please write in the first instance to the Works Superintendent, Instrument Division, giving details of experience. [5815

A KEEN energetic man required to take control of a design department for a small growing firm in the outer London Area, engaged on a variety of important airframe and other projects. The highest qualifications and experience are essential. Write in confidence to the Managing Director, Box No. 4848. [5849

RADIO Engineers required in Department of Flight for work on aircraft and workshop overhauls. M.T.C.A. Maintenance Engineer's Licence an advantage. Five day week. Generous holiday allowance. Staff superannuation and sick pay scheme. Application forms from Chief Clerk, The College of Aeronautics, Cranfield, Bletchley, Bucks. [5840

DEPUTY CHIEF INSPECTOR required in Department of Flight. Must be conversant with the operation of an approved inspection organization and hold A.M.E. licences in A and B or A and D. Salary according to qualifications and experience. Small house may be available if married. Staff superannuation scheme. Generous holiday allowance. Application forms from Recorder, The College of Aeronautics, Cranfield, Bletchley, Bucks. [5837

HUNTING AEROSURVEYS, LIMITED, require an Engineer with A and C licences and prepared to go overseas for six months in the year. Generous salaries are paid and a number of extra allowances are given for all work overseas. The company will provide and pay for training courses for satisfactory applicants to obtain necessary endorsements. The posts are permanent and pensionable. Apply 6 Elstree Way, Boreham Wood, Herts (ELStree 2214). [5835

EXPERIENCED Designer required by major aircraft company, capable of taking charge, directly under the Chief Designer, of technical staff dealing with projects, prototype and production aircraft. Applications, which will be treated in strict confidence, should give full details of age, experience, both practical and technical, and salary required to Box A.72, c/o Central News Ltd., 43, London Wall, London, E.C.2. If required a house would be available for successful applicant. [5831

TECHNICAL Author (electrical) required. Must be capable of preparing own wiring diagrams and routing charts and preferably with experience in writing technical publications to M.o.S. and A.R.B. requirements. Staff pension and life assurance scheme, good welfare facilities. Applications, giving full details of qualifications, experience, age and salary required, and quoting ref. MF/TA/6, should be addressed to the Personnel Manager, Hunting Percival Aircraft, Limited, Luton Airport, Beds. [5834

ARMSTRONG SIDDELEY MOTORS LIMITED require a first-class Mechanical Designer, aged 26/32, for their Project Design Office. Applicants must be works trained designers with at least Higher National Certificate and a sound background experience of aero engine design. The position offered is one of great and special interest and is an exceptional opportunity for a young engine designer to expand his experience in the gas turbine industry. Application with full details and in strictest confidence to the Chief Engineer, Armstrong Siddeley Motors Ltd., Coventry, quoting Ref. PD/MD. [5824

SITUATIONS WANTED

EX R.A.F. Pilot, 28, study. C.P.L. 250 hrs., seeks post enabling to take licence. Box 4847. [5848

BOOKS, ETC.

"DICTIONARY of Photography," 18th Edition, edited by A. L. M. Sowerby, B.A., M.Sc., F.R.P.S. This book has been established as a standard reference work for practising photographers, amateur and professional alike, for over sixty years. During that time it has been revised at frequent intervals and brought up to date. The present enlarged edition has been almost entirely re-written. The articles on "Colour Photography" and "Cinematography," specially contributed by Percy W. Harris, Hon. F.R.P.S., editor of "Modern Camera Magazine," and G. H. Sewell, A.R.P.S., respectively, have also been re-written in the light of recent developments. The dictionary also gives up-to-date formulæ for every process, new and old. 21s. net from all booksellers. By post 22s. 3d. from The Publishing Dept., Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1.

SIR W.G. ARMSTRONG WHITWORTH AIRCRAFT LTD.

ARMAMENTS DIVISION

Due to expanding commitments the Company wishes to increase its technical staff, and applications are invited for the following positions for work associated with guided weapons:

SENIOR DESIGNER

for the Birmingham office, to take charge of a section in the Ground Handling and Packaging Group. Age 27-37 years. Qualifications desired, HNC and, preferably, corporate membership of a senior Engineering institution.

STRESSMEN

Senior, intermediate and junior for Birmingham and Coventry offices. Qualifications desired, HNC in Mechanical, Aeronautical or Structural Engineering. At least two years experience is required for the senior and intermediate positions, but training will be given for the junior grades.

TECHNICIANS

For the Dynamics Group for vibration testing. Qualifications desired, Degree in Mechanical or Electrical Engineering or Physics, and apprenticeship. Age between 23 and 26 years. Men or Women graduates considered.

DRAUGHTSMEN

Senior and junior with light structural or mechanical design experience. HNC or ONC is required for the senior positions.

TECHNICAL ASSISTANTS

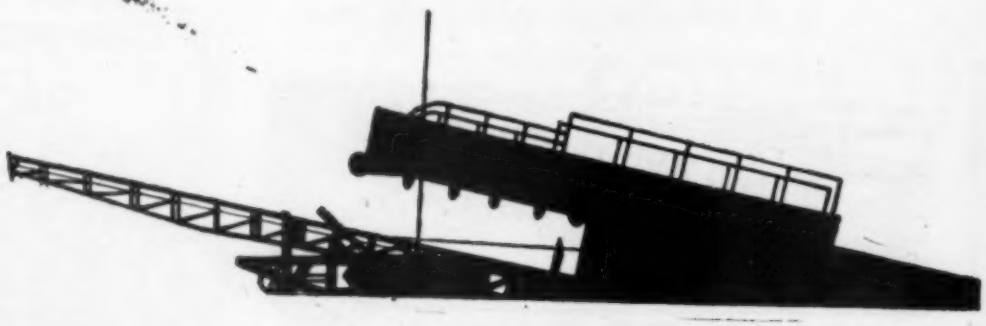
for the Mechanical Development Group. Experienced men with B.Sc. (Engineering) or HNC are required.

Also, for the recording section of the Electronics Group, experienced men with HNC or C & G (Final).

Generous salaries and excellent working conditions and amenities await you, the work is of a permanent character in a new and expanding field and an attractive Pension Scheme is in operation.

Replies should be addressed to the Technical Appointments Officer,

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.
BAGINTON - Nr. COVENTRY



THE HESTON AIRCRAFT CO. LTD.

HESTON AIRPORT, Hounslow, Middlesex

have immediate openings in their

DESIGN OFFICE

on a new and interesting Civil Aeroplane for:

SENIOR, INTERMEDIATE and JUNIOR DRAUGHTSMEN

EXPERIENCED STRESSMEN

LOFTSMEN

Long-Term Programme

Good opportunities

Please write with full particulars to:

THE CHIEF DESIGNER

BOOKS, ETC.

"MECHANICS for the Home Student," by Eric N. Simons, in association with W. D. Burnet, B.Eng., Lecturer in Mechanical Engineering at Sheffield University. The nineteen chapters of this practical book provide an excellent introduction to the subject under such headings as action, force, momentum, power, applied force, friction, centre of gravity, density, fluids, gases, heat, vibration, stress, impact, rotation, etc. 7s. 6d. net from all booksellers. By post 8s. 1d. from Iliffe & Sons, Ltd., Dorset House, Stamford St., London, S.E.1.

"PLASTICS Progress: Papers and Discussions at British Plastics Convention 1955." The complete text and illustration of the papers (given by 29 experts) together with a full report of the discussion. Subjects include: unplasticized p.v.c.; plastics materials developments; reinforced plastics; durability and performance of plastics in service; problems in injection moulding; economics of large mouldings; new uses in industry—cables, metallization, footwear and conveyor belting. 50s. net from all booksellers. By post 51s. 8d. from Iliffe & Sons, Ltd., Dorset House, Stamford St., London, S.E.1.

"DEVELOPMENT of the Guided Missile," 2nd Ed. by Kenneth W. Gatland, F.R.A.S. Presents all the main information now available on the development of guided weapons in Britain, U.S.A., Germany, U.S.S.R., and elsewhere. Other chapters discuss guided missiles as instruments of research into the upper atmosphere and outer space, and as vehicles of interplanetary travel. An appendix shows the characteristics of 130 powered missiles known to have been designed or constructed. 15s. 0d. net from all booksellers. By post 16s. 1d. from Iliffe & Sons, Ltd., Dorset House, Stamford St., London, S.E.1.

"ABACS or Nomograms," by A. Giet. Translated from the French by H. D. Phippon and J. W. Head. Most engineers have made use of nomograms at some time in their careers, and are fully alive to the fact that they are a very convenient tool when the same formula has to be solved repeatedly for several sets of variables. It is fair to say, however, that only a small proportion of even those who habitually employ nomograms know how to construct them for their own use. Most of the comparatively small literature on the subject is written for mathematicians and is extremely difficult for the practical engineer to comprehend. This book is essentially practical, and not only demonstrates the many and varied applications of the abac or nomogram, but shows how even those without highly specialized mathematical knowledge may construct their 35s. 10d. from the publishers: Iliffe & Sons, Ltd., own charts. 35s. 0d. net from all booksellers. By post Dorset House, Stamford Street, London, S.E.1.

A.V.ROE

DRAUGHTSMEN

There are vacancies in the Guided Weapons Division at Woodford Aerodrome, Cheshire, for the following categories of Draughtsmen:

Mechanical Draughtsmen

Electro Mechanical Draughtsmen

Electronic Draughtsmen

Instrument Draughtsmen

on highly original and interesting work. Excellent salaries and conditions.

Applications to:

The Personnel Manager, A. V. ROE & Co., Limited, Greengate, Middleton, Manchester,

quoting reference WRD/1D

Aluminium Sheet and Strip

SHEETS IN STANDARD OR SPECIAL SIZES
STRIP IN COIL OR STRAIGHT LENGTHS

SPECIFICATIONS L.4 L.16 L.17 L.59 L.60 L.61

DOLCAR ROC

APPROVED INSPECTORS A.I.D., A.R.B., ETC.

ALUMINIUM CORPORATION LIMITED

TELEPHONE YOUR REQUIREMENTS TO **LONDON TRAfalgar 3104**

SALES OFFICE: **30 CHARLES II STREET, LONDON, S.W.1** TRA. 3104

DELIVERIES BY OUR OWN TRANSPORT TO ALL PARTS OF THE COUNTRY

ROLLING MILLS, DOLGARROG, Nr. CONWAY, NORTH WALES DOLGARROG 211

Unsurpassed for: Dimensional accuracy. Balance. Finish. Long Life. Value. Available in English, American, Metric and Unified Sizes.

TOOL UP WITH CHROME ALLOY STEEL BRITOOL SERVICE TOOLS

JENKS BROTHERS LIMITED

BRITOOL WORKS BUSHBURY WOLVERHAMPTON

BOOKS, ETC.

"CELESTIAL Navigation for Yachtsmen," 3rd Edition. By M. Blewitt. This little book, intended especially for beginners, should receive a very warm welcome from every yachtsman who has wanted to learn the art of navigation by the heavenly bodies, but has been deterred by its apparent complexity. In particular, it will make an immediate appeal to all who feel their mathematics are not up to standard, for neither geometry nor trigonometry play any part in the author's explanation—indeed, even those who can manage little more than addition and subtraction should master this book with ease! 64 pages. Illustrated with 26 diagrams and graphs. Price 6s. net. By post 6s. 4d. from all booksellers, or Iliffe & Sons, Ltd., Dorset House, Stamford St., London, S.E.1.

★ *Ministry Approved Courses* ★
for the
Commercial Pilot and Instrument Rating
at the
LONDON SCHOOL OF AIR NAVIGATION
All subjects for professional pilot or navigator licences and ratings embracing Academic, Technical, Simulated and Flying aspects. Full-time personal coaching, also short periods. Home study excellent alternative.
33 OVINGTON SQUARE, KNIGHTSBRIDGE
LONDON, S.W.3. KEN. 8221
★ FLYING BASE: CROYDON AIRPORT ★

BOOKS, ETC.

"YACHTING Quizzes," by Max A. Chappell. Packed with information on everything nautical, from rides to trade winds, from fishing grounds to first aid. A book every enthusiast must read. 3s. 6d. net from all booksellers. By post 3s. 10d. from Iliffe & Sons, Ltd., Dorset House, Stamford St., London, S.E.1.

"CASH From Your Camera," by Arthur Nettleton, F.R.G.S. Shows how amateur photography can be made to pay for itself by the sale of pictures to newspapers, magazines, calendar publishers, etc., and deals with the many problems involved. 2nd Edition. 7s. 6d. net from all booksellers. 8s. 0d. by post from Iliffe & Sons, Ltd., Dorset House, Stamford St., London, S.E.1.

NEW C.I. Counter

This new C.I. counter has been specially designed for use in airborne instruments. Available with 3 or 4 figures and fitted with knob reset. Now in quantity production.

Operating Voltage 24 volts D.C.
Weight Approx. 2.75 ozs.
Rating 96 milliamps
Operating Speed Recommended maximum 16/20 counts per sec.

Write for details.

COUNTING INSTRUMENTS LTD
5 ELSTREE WAY, BOREHAM WOOD, HERTS
Telephone ELSTREE 1382-3-4

SHORT BROTHERS & HARLAND LIMITED
have vacancies for
ONE SENIOR AERODYNAMICIST

This is a post of responsibility with monthly status and appropriate salary.

DUTIES—To lead a team in the Aerodynamics Office on Aircraft design work of special interest.

QUALIFICATIONS—A University Degree or the equivalent coupled with considerable experience (at least five years) in general aerodynamics or in stability and control work.

Experience in the Aircraft Industry and in leading Junior Staff would be an advantage.

THREE AERODYNAMICISTS — For aircraft stability and control work, performance work, and for the Wind Tunnels.

QUALIFICATIONS — University Degree or the equivalent in Engineering, Physics or Maths with several years aerodynamics experience.

These jobs offer opportunities either for keen individualists or for those interested in achieving the wider responsibility involved in leading a team.

Housing and removal assistance.

Permanent and pensionable appointments.

Applications should be made to the:
Staff Appointments Officer,
SHORT BROTHERS & HARLAND LTD.,
P.O. Box 241, BELFAST,
quoting S.A.191.

INDEX TO ADVERTISERS

	Page
Aero Maintenance Equipment, Ltd.	27
Aeronautical Trades and Manufacturing Co., Ltd.	27
Aircrew Co. and Jicwood, Ltd., The	20
Aluminium Corporation, Ltd.	33
"Amateur Photographer"	24
Armstrong Siddeley Motors, Ltd.	16, 28
Armstrong Whitworth Aircraft, Ltd., Sir W. G.	28, 32
Anton and Co., Ltd., E. S.	26
"Autocar, The"	4
Aviation Traders, Ltd.	27
B.B. Chemical Co., Ltd.	14
Birkett, Billington and Newton, Ltd., T. M.	6
B.K.S. Engineering, Ltd.	27
Blackburn and General Aircraft, Ltd.	30, Cover i
Box No. 340	30
Bristol Aircraft, Ltd.	28, Cover iv
British European Airways	28
Brooklands Aviation, Ltd.	28
B.S.T. Aeronautical Co., Ltd.	26
Collins Supply Co.	27
Counting Instruments, Ltd.	34
Cross Manufacturing Co. (1938), Ltd.	25, 27
Curd Components, Ltd.	26
"Daily Mail"	27
Derby Aviation, Ltd.	25
Dunlop Rubber Co., Ltd.	18, 19
Dzus Fastener Europe, Ltd.	22
English Electric Co., Ltd.	11, 21, 28, 30
Fairey Aviation Co., Ltd., The	15
Ferranti, Ltd.	28
Field Aircraft Services, Ltd.	26
Fishers	27
Flight Refuelling, Ltd.	12
Garringtons, Ltd.	Cover iii
Gloster Aircraft, Ltd.	29, 30
Haig's Fund—Poppy Day	25
Handley Page, Ltd.	8
Helicopter Services, Ltd.	26
Heston Aircraft Co., Ltd., The	33
Hobson, Ltd., H. M.	1
Iliffe and Sons, Ltd.	4, 24
Jenks Brothers, Ltd.	33
Lewis, Ltd., D.	26
Light Soldering Developments, Ltd.	25
London School of Air Navigation	34
Marshall's Flying School, Ltd.	29, 30
Metal Gravure Co., Ltd., The	24
Napier and Son, Ltd., The	30
Orenda Engines, Ltd.	Cover ii
Percival Aircraft Ltd., Edgar	30
Redifon, Ltd.	10
Rists Wires and Cables, Ltd.	3
Robinson and Co. (Gillingham), Ltd., L.	24
Roe and Co., Ltd., A. V.	31, 33
Rotol, Ltd.	9
Rubery Owen and Co., Ltd.	20
Sangamo Weston, Ltd.	22
Saunders-Roe, Ltd.	28
Short Brothers and Harland, Ltd.	34
Simmonds Aerocessories, Ltd.	5
Smiths Aircraft Instruments, Ltd.	17
Teddington Aircraft Controls, Ltd.	23
Transair, Ltd.	30
Triplex Safety Glass Co., Ltd.	2
Vaughan and Co., Ltd., Edgar	23
Vernons Industries, Ltd.	7
Vokes, Ltd.	2
Western Manufacturing (Reading), Ltd.	6
Wiggin and Co., Ltd., Henry	13
Wilson and Sons (London), Ltd., W.	4

Printed in Great Britain for the Publishers, ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1, by SUN PRINTERS LTD., London, and Watford, Herts. Flight can be obtained abroad from the following: AUSTRALIA AND NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service, Ltd.; Gordon & Gotch, Ltd. SOUTH AFRICA: Central News Agency, Ltd.; Wm. Dawson & Sons (S.A.), Ltd. UNITED STATES: The International News Co. Entered as Second Class Matter at the New York, U.S.A., Post Office.

THE TECHNIQUE OF FORGING

. . . demands continuous research and the application of quality control. One of the most important requirements to ensure strong forgings with optimum machinability — at the rate of 75,000,000 per year — is the attainment of the correct grain flow and microstructure which are as essential as compliance with the generally specified chemical composition and physical properties. All materials used in Garrington's forgings are carefully examined in their new laboratories to ensure that these exacting requirements are fulfilled.

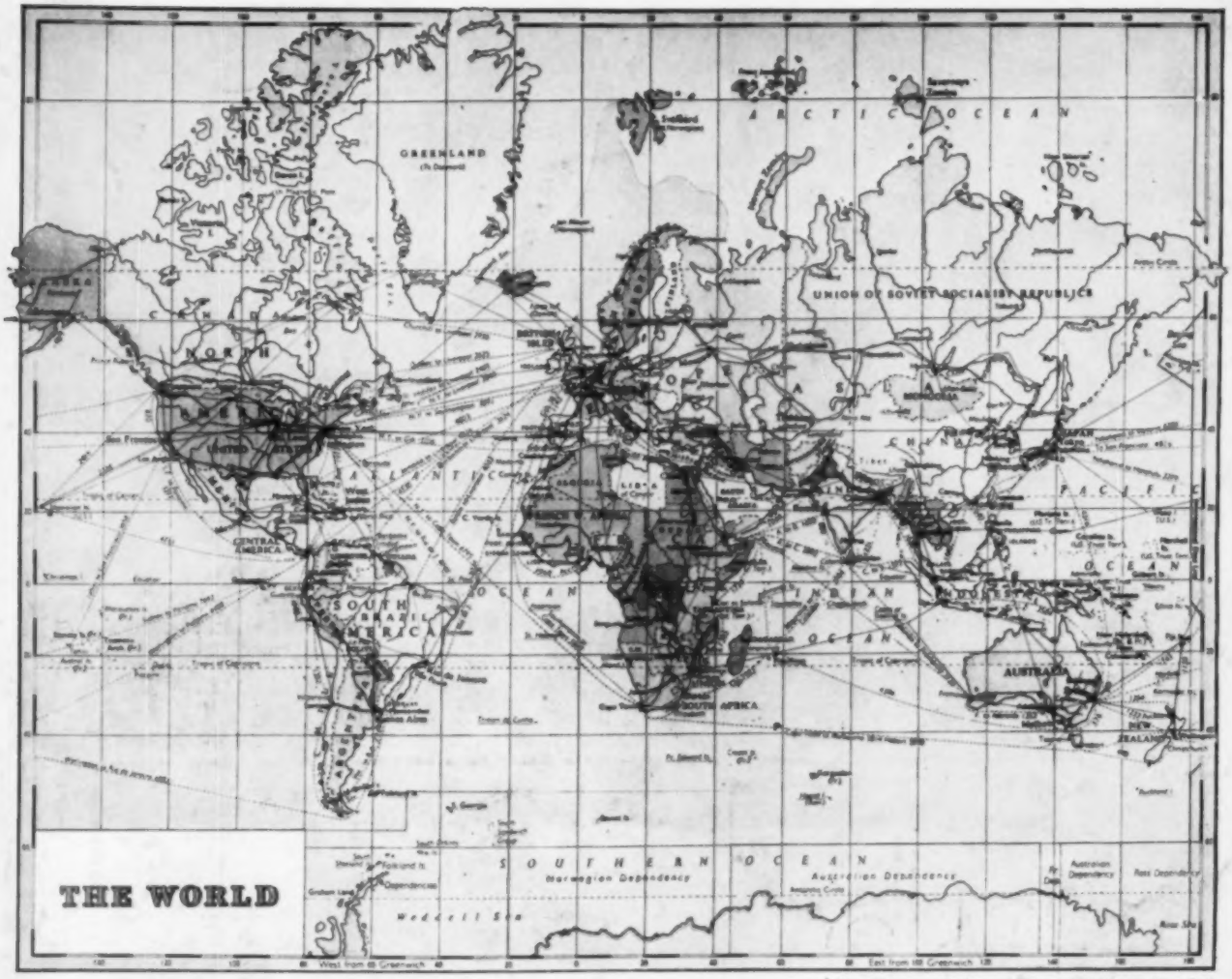
So well expressed

by

G A R R I N G T O N S

B R O M S G R O V E · D A R L A S T O N

FLIGHT
26 October 1956



Map by permission of George Philip & Son Ltd.

"GIT THAR FUSTEST WITH THE MOSTEST"

A laconic comment by General Nathan Bedford Forrest during the American Civil War is still the prime rule of logistics

GENERAL FORREST'S SUCCINCT RULE for victory in battle has become a cornerstone of mid-Twentieth Century logistics. There is, perhaps, some irony in the fact that the fiery old General's dictum applies with equal force to military actions specifically designed to prevent or limit warfare.

The capacity of the Bristol Britannia to increase the mobility and striking power of military units has been shown up by its performance on trooping operations during the Suez emergency. Though no details of trooping movements may be given, the Under-Secretary of State for Air recently told the House of Commons that two battalions of troops could be moved from Britain to Cyprus in 40 hours, using only five Britannias.

The Britannia can carry 110 fully armed troops at a speed of 360 mph over a stage distance of 4000 miles without refuelling. It can also take equipment such as jeeps, 25-pounder guns, large jet engines; or alternatively it can carry mixed loads of personnel and military stores. No other military transport can equal this performance.

The Britannia 250 *Maximum payload:* 35,000 lb. *Still air range (with 20,000 lb payload):* 5750 miles. *Maximum cruising speed:* 400 mph. Powered by four Proteus 755 turboprop engines of 4120 ehp. Britannia 250 transports have been ordered by Royal Air Force Transport Command.

BRISTOL AIRCRAFT LIMITED